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A data-driven allocation tool for in-kind resources distributed by a state health department

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Abstract

Objective—The objective of this study was to leverage a state health department's operational data to allocate in-kind resources (children's car seats) to counties, with the proposition that need-based allocation could ultimately improve public health outcomes.

Methods—This study used a retrospective analysis of administrative data on car seats distributed to counties statewide by the Georgia Department of Public Health and development of a need-based allocation tool (presented as interactive supplemental digital content, adaptable to other types of in-kind public health resources) that relies on current county-level injury and sociodemographic data.

Results—Car seat allocation using public health data and a need-based formula resulted in substantially different recommended allocations to individual counties compared to historic distribution.

Conclusions—Results indicate that making an in-kind public health resource like car seats universally available results in a less equitable distribution of that resource compared to deliberate allocation according to public health need. Public health agencies can use local data to allocate in-kind resources consistent with health objectives; that is, in a manner offering the greatest potential health impact. Future analysis can determine whether the change to a more equitable allocation of resources is also more efficient, resulting in measurably improved public health outcomes.

Keywords

accidents; traffic; financing; government/supply and distribution; economics/statistics and numerical data

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Introduction

The Georgia Department of Public Health (GADPH) receives annual funding from the Georgia Governor's Office of Highway Safety and NHTSA to provide car seats as in-kind resources to Georgia counties, where agencies distribute the seats to eligible families with children aged 0–9 years through educational classes or one-on-one appointments. The public health goal of the program is to reduce children's motor vehicle traffic crash (MVC) injuries and fatalities. In 2013 more than 500 children 9 years of age and under died as occupants in MVCs nationally, and nearly 90,000 sustained nonfatal injuries treated in hospital emergency departments (Centers for Disease Control and Prevention [CDC] 013; NHTSA 2015a). Georgia ranks slightly above the U.S. average for total MVC fatalities, all ages, based on miles traveled (1.18 versus 1.14 per 100 million vehicle miles; U.S. Census Bureau 2012a).

Car seats substantially reduce children's risk of MVC fatal and nonfatal injuries (CDC 2015). However, many families do not use car seats appropriately and there is some evidence that proper use varies with sociodemographic factors (CDC 2015; Macy et al. 2014). Just 2 studies—summarized in a recent review—have investigated car seat use or injury reduction associated with free car seat programs; those studies identified some increased car seat use associated with such programs (Jacob et al. 2014).

There is increasing interest in using data at all geographic scales to optimize public health financial resource allocation, although we are not aware of a peer-reviewed published tool for allocating in-kind public health resources to U.S. counties (Everett et al. 2013; Graham and Mackie 2015; Polo et al. 2015; Yaylali et al. 2015). The aim of this exploratory study was to leverage GADPH operational data to create a need-based allocation algorithm for the department's car seat program, with the proposition that need-based allocation could ultimately improve public health outcomes.

Methods

Collaboration between the GADPH and the CDC's National Center for Injury Prevention and Control, Division of Analysis, Research, and Practice Integration resulted in an algorithm that uses GADPH operational program data and county-level sociodemographic data to assign available car seats to the state's counties based on objective measures of need. The algorithm is implemented as an interactive spreadsheet tool that appears as Appendix S1 (see online supplement). The tool was designed for adaptation to any type of public health resource—in the spreadsheet, analysts can alter contributing data factors and associated weighting to suit local purposes.

The primary study outcome was the conceptualization of a need-based allocation algorithm for children's car seats and development of a corresponding spreadsheet tool for the state's future use. The secondary study outcome was a comparison of the number of car seats and rate per 1,000 eligible population that Georgia counties received under the historic allocation system, where car seats were equally available to all counties, versus the recommended need-based allocation. This study used administrative data and did not involve human subjects.

Historic car seat distribution system

From January 2012 through September 2014, the GADPH distributed an annualized 5,670 car seats (4,408 car seats with 5-point harnesses for children aged 0–4 and 1,262 booster seats for children aged 5–9) statewide. Historically, the GADPH offered a specific number of car seats with harnesses and booster seats to participating Georgia counties (as of July 2015, all but 7 of Georgia's total 159 counties) on a monthly basis. Most recently, such counties were eligible for up to 8 car seats with harnesses and 4 booster seats each month. To receive car seats, Georgia counties were required to provide car seat safety training meetings on a monthly basis to county residents, during which county officials identified families eligible for and in need of free car seats. Upon receiving counties' monthly car seat requests, the GADPH communicated shipping instructions to its selected car seat supplier.

Under the existing car seat distribution system, counties with staff and resources to devote to the program had the greatest chance of securing the maximum number of available car seats each month. As such, GADPH staff recognized that this system had the potential for misalignment between operational procedures and program goals; that is, counties with the resources to hold safety training meetings and comply with GADPH requirements were not necessarily those with the greatest need for car seats, where need is primarily defined by a combination of high MVC injury rates among children 0–9 years old and socioeconomic disadvantage. The existing distribution system was presumably effective at distributing car seats to families with economic need for car seats but not necessarily effective at distributing car seats to families at greatest risk for children's MVC injuries. A situation in which counties with greater need for car seats do not receive them is potentially both inequitable—or unfair—and ineffective, where effectiveness is defined the maximum reduction in children's MVC injuries resulting from the distribution of these in-kind resources. The GADPH requested collaboration with CDC's National Center for Injury Prevention and Control to assess the extent of misalignment between its car seat program operations and goals and to explore more data-driven allocation options.

The equity loss resulting from the state's system of making car seats equally available to all counties can be measured as the difference between the number of car seats each county received under such a system and the number each county would have received under a need-based allocation system. The present study was concerned with this equity analysis. The effectiveness of a need-based car seat allocation is suited to a future study, in which children's MVC outcomes by county could be compared under both car seat allocation approaches.

Data

The need-based car seat allocation algorithm incorporates four county-level data elements, all derived from the Georgia Department of Health Online Analytical Statistical Information System (OASIS; Georgia Department of Health 2008–2014). The first data element represents the sum of each county's rate of MVC fatalities, emergency department visits, and hospital discharges among county residents (i.e., regardless of where the MVC took place) aged 0–4 years and 5–9 years, measured through data from the Georgia Department of Transportation and NHTSA as cumulative 5-year incidence rate per 100,000 population per year. MVC fatalities were identified via International Classification of Diseases, 10th edition codes V30–V79 (.4–.9), V83–V86 (.0–.3), and nonfatal MVC injuries were identified via International Classification of Diseases, ninth edition, Clinical Modification codes E810–E819 (.0–.1, and .8–9, excluding pedestrians, pedal cyclists, and motor cyclists). The second data element represents county poverty, measured as the most recent single-year annual percentage of all people in poverty by county according the U.S. Census Bureau (2012b). The third data element represents each county's demonstrated distribution capacity, measured as the percentage of allocated car seats the county successfully distributed to eligible families in the prior year. This element was initially set to 100%, designed to be adjusted based on counties' future performance. The fourth data element represents the size of each county's potential recipient population, measured as the most recent single-year annual numbers of county residents aged 0–4 and 5–9 years old (Georgia Department of Health 2008–2014).

Calculations

Separate allocations were determined for car seats with harnesses and booster seats. Based on the 4 data elements, an algorithm calculates the annual allocation for each county as follows (calculations demonstrated in Appendix S1):

1. Each contributing data measure (e.g., MVC injury incidence rate) is standardized as (County measure – Average of all counties)/Standard deviation of the measure.
2. A weighted sum of the standardized measures (referred to as a county's raw score) is calculated such that a county's MVC injury incidence rate measure contributes 60%, the poverty rate contributes 30%, and the demonstrated distribution capacity contributes 10%. Weights were selected a priori based on consideration of the car seat program's public health goals, as well as the need to ensure actual distribution of allocated resources. A calculated raw score less than zero is reset to zero.
3. The county's raw score is weighted by the county's eligible population (children aged 0–4 for car seats with harnesses and children aged 5–9 for booster seats) to yield the county's population-adjusted score. For any 2 counties with raw scores greater than zero, this population based weighting step ensures that the ratio of car seats allocated per 1,000 eligible children will align with the ratio of the raw scores. Hence, if a county has a high raw score relative to other counties, that county receives a disproportionately higher allocation per 1,000 eligible children.
4. Car seats are allocated to each county based on the county's population-adjusted score as a proportion of the sum of the population-adjusted scores across all counties. For example, if a county's population-adjusted score

amounts to 2% of the sum across all counties, that county is allocated 2% of available car seats.

Additional allocation considerations

A state health department's allocation of in-kind public health resources realistically may be guided not only by recipient counties' need-based criteria but also by financial, logistical, and community considerations. Therefore, in addition to the original allocation algorithm described above (henceforth, the "original" allocation or allocation option 1) we developed 4 alternative allocation options to offer GADPH flexibility under changing conditions, to be selected by GADPH decision makers as appropriate. Calculations and results for all allocation options (i.e., options 1–5) are demonstrated in Appendix S1. The alternative options were conceptualized as follows:

1. Can extra funding be devoted to the program? (Financial)
2. Is it feasible for counties to receive a very low number of car seats (for example, at least one but fewer than 5)? (Logistical)
3. Is it acceptable for counties to receive zero car seats? (Community)

The decision table shown in Table 1 maps the responses to these 3 considerations to the corresponding allocation option. Allocation options 2 and 3 do not call for extra resources, relying instead on rearrangements of the original allocation to meet the minimum county-specific allocations imposed by the indicated constraints. Insofar as possible, these 2 options continue to adhere to the car seat need-per-population ratios. Allocation options 4 and 5 assume the availability of extra resources in order to meet county-specific minimum allocations; as such, these 2 options result in allocations that diverge from the car seat need-per-population ratios. One way to conceive of the last 2 options is that they quantify the marginal resources needed under an allocation scheme that is not strictly constrained by the immediately available resources. A practical application of the results of options 4 and 5, therefore, would be a situation in which a distributing public health agency had the opportunity to apply for additional funding. The 5 allocation options demonstrated in the spreadsheet tool (Appendix S1) can be described as follows:

1. Need-based allocation (original). Described previously, this is the original need-based allocation option based exclusively on the car seat need-per-population ratios.
2. Need-based allocation with minimum seats to all counties. Within existing resources, this allocation option ensures a minimum number of car seats (for example, 5) to all counties. Counties receiving car seats in excess of the minimum under the original allocation have their allocation reduced proportionately to provide seats to other counties, consistent with the car seat need-per-population ratios.
3. Need-based allocation with minimum seats to counties with >0 original allocation. This allocation option avoids a situation in which excessive resources are required to deliver small numbers of car seats to individual counties. Within existing resources, this allocation option ensures a

minimum number of car seats (for example, 5) to all counties assigned at least one car seat in the original allocation. For example: A county originally allocated 2 car seats would see its allocation increase by 3 car seats (given the example minimum); a county originally allocated zero car seats would still receive zero car seats; and a county originally assigned 10 car seats would see its allocation reduced proportionately to provide seats to other counties, consistent with the car seat need-per-population ratios.

4. Minimum allocation to all counties. Similar to allocation option 2, this option ensures a specified minimum number of car seats to all counties. However, extra resources are assumed available and therefore, counties assigned greater than the specified minimum number under the original need-based algorithm do not see their allocation reduced. Allocations under this option will not generally conform to the car seat need-per-population ratios established in the original allocation.

5. Minimum allocation to all counties with >0 original allocation. Similar to allocation option 3, this allocation option ensures a minimum number of car seats to all counties that received at least one car seat in the original need-based allocation (though a county originally allocated zero car seats would still receive zero car seats). However, extra resources are assumed available and, therefore, counties assigned greater than the specified minimum number under the original need-based algorithm do not see their allocation reduced. Allocations under this option will not generally conform to the car seat need-per-population ratios established in the original allocation.

Results

Calculations for car seat allocations were done at the county level (reported in Appendix S1), with results summed to the level of Georgia public health districts (GPHD; consisting of single counties and multicounty groupings) for presentation here. Table 2 shows both the average annualized number of car seats and the rate of seats per 1,000 population age 0–9 years old distributed to each of 18 GPHDs during recent years compared to the number and rate of car seats that would have been allocated to each GPHD under the 5 allocation options in the new algorithm. The minimum allocations (selectively applied depending on the allocation option) were assumed to be 5 harness seats and 5 booster seats per county. The changes across the GPHDs under option 1 are in both directions, ranging from +300% (with an annual change in car seats received by one GPHD from 52 historically to 208 with the need-based allocation) to −100% (affecting 4 GPHDs, the largest loss in terms of number of seats was a reduction of 200 car seats to zero car seats in one GPHD).

Of the two alternative allocation options that were restricted to existing resources (options 2 and 3), the results obtained under option 3 are more similar to those from option 1. Of the 2 options allowing the introduction of extra resources (options 4 and 5), option 4 (the more generous of the 2) produces results that can be quite different from both the historic allocation and the results obtained under any of the other need-based allocation options. Option 5 gives results that are most closely comparable to those obtained under option 3.

Discussion

This work focused on a state health department's operational details associated with distributing one type of in-kind public health resource (car seats) to a specific population (low-income families). We demonstrated that a hypothetical, data-driven, need-based allocation of this resource results in a substantially different distribution compared with the existing practice of making the resource equally available to all receiving entities; in this case, Georgia counties.

Certain limitations to the proposed need-based allocation approach, as well as implementation issues that are yet to be addressed, should be recognized. Allocating resources based on county-level characteristics cannot account for variations among residents within counties. For example, a county with a low children's MVC injury rate and low poverty rate might receive zero car seats through this allocation, although such a county still might have many families in need. A car seat allocation system operating at the family level—in which each family's socioeconomic circumstances and risk for children's MVC injuries could be ranked—rather than county level would more closely align with conceptual issues of equity. However, given the presumably insurmountable information challenges associated with such a system, county-level allocation provides a practical and reasonable approach. We were not able to compare Georgia's historic approach to car seat allocation or our proposed need-based allocation to program practices in other states. It appears NHTSA does not publish information on the administration of car seat programs in state and local areas (NHTSA 2015b). There is no way to ensure that car seats, once distributed, are appropriately used by each recipient family—there is evidence that even highly educated parents at times use car seats improperly (Ferguson et al. 2013)—although car seat safety training meetings aim to ensure that all recipient families know how to use car seats properly. Our algorithm assumes that vehicle ownership is proportional to population size, which may not be the case; for example, in counties with high poverty. Another limitation is that we did not have sufficient data to account for other organizations that may be involved in car seat distribution. GADPH staff are aware of both counties in which the state's public health grantees are the only entity distributing car seats, as well as counties in which other organizations are involved in distributing car seat resources.

We have included the children's MVC injury rate in the allocation algorithm as the most important factor because this is the public health measure that the car seat program seeks to influence. Such injuries might also plausibly be linked to the prevalence of improper car seat use. County-level poverty was included in our algorithm because the car seat program also seeks to distribute car seats to families that otherwise would not be able to afford them. The MVC injury rate and the poverty rate independently affect districts' allocation of car seats. For example, if the children's MVC injury rate were the only allocating factor under allocation option 1, GPHD 17 would be allocated just one car seat, compared to 858 car seats when the algorithm includes the poverty measure (see Table 1 for allocation option 1 results for all districts; sensitivity analysis with MVC injury rate or poverty rate as sole allocation factors not demonstrated). Alternatively, if only the poverty rate were taken into consideration under allocation option 1, GPHD 4 would receive 84 car seats, compared to zero car seats when the algorithm includes the MVC injury rate.

To fully implement the proposed allocation approach, further considerations and procedural decisions are involved. For example, given that the need-based distribution suggests large gains for some counties at the expense of others, what community ramifications might be anticipated? Noting that a number of counties with very low prior participation—perhaps indicating low capacity for participation—would receive substantially more car seats, what procedural and reporting requirements should be required in order to avoid burdening counties that might have great need for seats but limited capacity? If a county does not succeed in identifying recipient families for all of its allocated car seats, what process should be implemented to make those seats available to other counties that have identified recipient families in numbers exceeding the indicated allocations? To investigate the feasibility of moving from its existing car seat distribution system to the need-based allocation described here and to further define the accompanying operational procedures, the GADPH may implement a pilot program.

This study has proposed what can reasonably be regarded as a more equitable allocation of state resources, because counties with greater relative need would receive greater resources. However, at this time we do not have the data to investigate the effectiveness of the alternate proposed allocations; that is, whether such allocations reduce children's MVC injury rates among families that receive car seats. A future study might investigate this issue directly using GADPH data before and after implementation of the need-based car seat allocation approach.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

Centers for Disease Control and Prevention. [Accessed April 2, 2015] Web-based Injury Statistics Query and Reporting System (WISQARS). 2013. Available at: http://www.cdc.gov/injury/wisqars

Centers for Disease Control and Prevention. [Accessed March 30, 2015] Child passenger safety: get the facts. 2015. Available at: http://www.cdc.gov/motorvehiclesafety/child_passenger_safety/cps-factsheet.html

Everett KH, Potter MA, Wheaton WD, Gleason SM, Brown ST, Lee BY. Geospatial analytics to evaluate point-of-dispensing sites for mass immunizations in Allegheny County, Pennsylvania. J Public Health Manag Pract. 2013; 19(Suppl 2):S31–S36. [PubMed: 23903392]

Ferguson, RW.; Green, A.; Walker, L. Buckle Up: Every Ride, Every Time. Washington, DC: Safe Kids Worldwide; 2013.

Georgia Department of Health. [Accessed November 11, 2014] Online Analytical Statistical Information System. 2008–2014. Available at: https://oasis.state.ga.us/

Graham JR, Mackie C. Criteria-based resource allocation: a tool to improve public health impact. J Public Health Manag Pract. 2015 epub ahead of print.

Jacob V, Chattopadhyay SK, Elder RW, et al. Economics of mass media health campaigns with health-related product distribution: a community guide systematic review. Am J Prev Med. 2014; 47:348–359. [PubMed: 25145619]

Macy ML, Cunningham RM, Resnicow K, Freed GL. Disparities in age-appropriate child passenger restraint use among children aged 1 to 12 years. Pediatrics. 2014; 133:262–271. [PubMed: 24420814]

NHTSA. [Accessed April 2, 2015] Fatality Analysis Reporting System. 2015a. Available at: http://www.nhtsa.gov/FARS

NHTSA. [Accessed December 12, 2015] Highway Safety Grant Programs. 2015b. Available at: http://www.nhtsa.gov/About+NHTSA/Highway+Safety+Grant+Programs

Polo G, Acosta CM, Ferreira F, Dias RA. Location-allocation and accessibility models for improving the spatial planning of public health services. PLoS One. 2015; 10(3):e0119190. [PubMed: 25775411]

US Census Bureau. [Accessed March 30, 2015] The 2012 Statistical Abstract—Transportation: Motor Vehicle Accidents and Fatalities. Table 1104—Traffic Fatalities by State. 2012a. Available at: http://www.census.gov/compendia/statab/cats/transportation/motor_vehicle_accidents_and_fatalities.html

US Census Bureau. [Accessed November 11, 2014] Small area income and poverty estimates (SAIPE), "State and County Estimates for 2012". 2012b. Available at: https://www.census.gov/did/www/saipe/

Yaylali E, Farnham PG, Schneider KL, et al. From theory to practice: implementation of a resource allocation model in health departments. J Public Health Manag Pract. 2015 epub ahead of print.

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Table 1

Decision tool for selecting an allocation option.

Can extra resources be devoted to the program?	Is it feasible for counties to receive a very low number of car seats?	Is it acceptable for counties to receive zero car seats?	Allocation option
No	Yes	Yes	1 (Original)
No	No	No	2
No	No	Yes	3
Yes	No	No	4
Yes	No	Yes	5

Table 2

Annualized number of car seats and rate per 1,000 residents age 0–9 years previously distributed compared to proposed need-based allocation options, by Georgia public health district.[a]

		Previous distribution		Need-based allocation option 1		Need-based allocation option 2		Need-based allocation option 3		Need-based allocation option 4		Need-based allocation option 5	
Public health district	Population 0–9 years old	Average annual distribution, no. car seats	Cars seats received per 1,000 population rate	No. car seats	Rate per 1,000	No. car seats	Rate per 1,000	No. car seats	Rate per 1,000	No. car seats	Rate per 1,000	No. car seats	Rate per 1,000
1	86,073	318	3.69	340	3.95	356	4.14	337	3.92	402	4.67	342	3.97
2	61,546	327	5.31	45	0.73	81	1.32	46	0.75	87	1.41	47	0.76
3	87,162	600	6.88	89	1.02	169	1.94	95	1.09	181	2.08	96	1.10
4	117,886	200	1.70	0	0.00	20	0.17	0	0.00	20	0.17	0	0.00
5	129,182	49	0.38	0	0.00	10	0.08	0	0.00	10	0.08	0	0.00
6	42,938	72	1.68	169	3.94	136	3.17	165	3.84	169	3.94	169	3.94
7	156,110	173	1.11	0	0.00	30	0.19	0	0.00	30	0.19	0	0.00
8	100,416	81	0.81	0	0.00	10	0.10	0	0.00	10	0.10	0	0.00
9	106,397	246	2.31	666	6.26	613	5.76	660	6.20	723	6.80	673	6.33
10	18,154	52	2.86	204	11.24	213	11.73	218	12.01	241	13.28	221	12.17
11	69,714	451	6.47	354	5.08	355	5.09	362	5.19	420	6.02	370	5.31
12	64,888	344	5.30	943	14.53	839	12.93	928	14.30	1,001	15.43	946	14.58
13	52,570	378	7.19	306	5.82	334	6.35	312	5.93	383	7.29	318	6.05
14	36,228	333	9.19	67	1.85	112	3.09	74	2.04	126	3.48	76	2.10
15	49,560	491	9.91	661	13.34	629	12.69	657	13.26	716	14.45	666	13.44
16	49,225	803	16.31	606	12.31	595	12.09	611	12.41	674	13.69	619	12.57
17	84,523	372	4.40	858	10.15	793	9.38	843	9.97	928	10.98	858	10.15
18	59,169	381	6.44	364	6.15	375	6.34	362	6.12	428	7.23	368	6.22
	Total	5,670		5,670		5,670		5,670		6,549		5,769	

[a]Column entries do not sum to displayed totals due to rounding. Georgia Public Health District numbers assigned arbitrarily; GPHD traditionally identified by name (i.e., Northwest Health District). Allocation results for individual counties (also identified by arbitrarily assigned numbers) demonstrated in Appendix S1 were summed to GPHD level for presentation in this table. Historic number of car seats distributed by county annualized based on number of seats distributed from January 2012 to September 2014 (or 33 months). Population size based on average of annual size 2012–2014 (Georgia Department of Health 2008–2014).