Injury Prevention: Poisoning

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Topic
Injury prevention

Introduction

Accidental poisoning remains a very common cause of childhood injury and death worldwide.[1-3] The National Poison Surveillance System of the American Association of Poison Control Centers reported 1,607,054 poisonings in children age 0-19 years in 2009.[1] In spite of significant efforts at prevention, this number has remained fairly constant over more than a decade. The Centers for Disease Control and Prevention (CDC) Wonder database reported a total of 916 deaths from unintentional poisoning in the years 1999-2007 in the age range 0-14 years.[4,5] A study of 2004 data from the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System (CPSC NEISS) estimated that 86,194 children <5 years of age were seen in emergency departments for poisoning events, with 13.3% admitted.[6] Where the poisoning site was known, 98% occurred in the home. In older children an increasing proportion of unintentional poisonings involve abuse of drugs. Much effort has been devoted to understanding the dynamics of these events and to designing strategies to either prevent their occurrence or minimize the consequences.

Subject

Poisoning is defined as exposure to a potentially harmful substance not intended for use by the person exposed. The definition in the context of this review also includes situations where medication is taken in excess of prescribed or appropriate doses. In older children and teens a substantial portion of poisoning cases are either drug abuse or suicide attempts. This review will not address the issues of drug abuse and suicide prevention. It will also not address programs aimed at specific problems such as pesticide toxicity among agricultural workers and their families, carbon monoxide detectors in the home, and lead poisoning prevention.

Problems

Poisoning appears to have its greatest impact in populations that are socioeconomically disadvantaged.[2,7] These populations have more limited access to preventive information and strategies, as well as more restricted access to medical care. The agents most commonly responsible for childhood poisonings vary widely in different parts of the

world. In North America and Europe most childhood poisonings involve medications, either prescription or over-the-counter medications (OTC). In developing countries poisonings are more likely to involve pesticides, hydrocarbons or caustics. Analysis of data from the National Electronic Injury Surveillance System for 2004 and 2005 estimated 103,441 emergency department visits annually for unintentional poisonings in children ≤18 years of age in the U.S.[8] Pharmaceutical products accounted for 69% of these visits. Of these, 82% were unsupervised ingestions and 81% were in children ≤5 years of age. A number of risk factors have been identified which increase the risks for a poisoning event. These include such things as single parent families, disrupted families, parents with psychiatric problems, the age and sex of the child as well as their behaviour characteristics, the use of child safety measures in the home, and the socioeconomic status of the family. Several approaches, both active and passive, have been studied to reduce the morbidity and mortality associated with childhood poisoning. These approaches include: regulatory, educational (both of the parent/caregiver and/or the child) using a wide variety of modalities and venues, technology and aversion. Despite the use of many of these modalities for decades, the rate of poisoning events in children has not been reduced, although the death rate from poisoning in young children in developed countries has been dramatically reduced. Many countries have seen the development of sophisticated poison information systems, aimed at providing parents easy access to both preventive information and emergency treatment information in the event of a poisoning. These centers have significantly contributed to the reduction of morbidity and mortality when childhood poisoning does occur.[9]

Research Context

The epidemiology and magnitude of childhood poisoning have been well studied in the developed countries. Most efforts at poison prevention have focused on improving parental awareness or behaviour through some variety of educational effort.[10] These efforts have involved one-on-one parental education in the home or healthcare delivery site, group or community educational efforts, passive education through mass-distributed educational content (brochures, internet, television, etc.), and education of preschool-age children in a classroom environment. In general, studies on these educational efforts have been able to demonstrate changes in parent/child knowledge, and to a lesser degree behaviour.[11] Most studies have not looked at decreased poisoning events as an endpoint, and those that have generally haven't found a significant impact. Many groups have been involved in the development of such materials, but there is no accepted content or delivery method.[12,13]

Starting with the Poison Prevention Packaging Act (1970), various regulatory approaches have been instituted to prevent or minimize childhood poisoning. These include child-resistant closures (CRCs) for medications and toxic consumer products, limited quantities in bottles of some OTC medications, and unit-dose packaging for some medications. The little data available on the effectiveness of these approaches, suggests that these approaches are effective where they are used properly.[14] The last three decades have seen the development of many devices for home use designed to prevent children's access to toxic materials. These include drawer and cabinet locking devices and storage containers for medications and toxic home products designed to be child-resistant. There is no data

on the effectiveness of these devices. Finally, several aversive techniques have been tried to discourage children's attraction for toxic materials. The first were a collection of sticker logos designed in the 1970's to scare children away from toxic materials. The most famous is "Mr. Yuk," which is still used today.[15] Several studies suggest that stickers are ineffective.[16-18] Bittering agents have been tried, particularly as an additive to *ethylene glycol*.[19,20] Limited data suggests that these agents may be useful in decreasing the severity of ingestions of some products.[20]

Key Research Questions

Do the CRCs that are currently available reduce the incidence or severity of childhood poisonings when used appropriately? Why do consumers circumvent or disable CRCs? Is unit-dose packaging superior to CRCs for the prevention of childhood poisoning from pharmaceuticals?

Is there a practical, cost-effective parental education program that reduces the incidence of childhood poisonings?

Recent Research Results

While the last 40 years have seen a dramatic decline in the number of pediatric deaths from poisoning in the developed world, there has been no discernable decrease in the rate of pediatric unintentional poisoning. Preventive strategies for pediatric poisoning, as for many other injury prevention efforts, have generally evolved around a two-pronged approach: parental education to increase awareness of the problem and change preventive behaviours in the home, and passive approaches, including the use of CRCs and other in-home devices, to prevent child access to poisons.

Following the introduction of CRCs several studies were done to look at their impact on child morbidity/mortality, particularly for the ingestion of aspirin, the first product affected. This data, together with data on other products commonly dispensed in CRCs was most recently reviewed by Rodgers.[14] The conclusion reached was that CRCs are a significant deterrent to pediatric ingestions. However, much has changed with CRCs in the last few decades, including their design and the regulatory requirements defining their effectiveness. CRCs now require that 80% of children 42-51 months of age cannot open the CRC within 5 minutes.[21] They also require that they be easily accessible by adults ages 55-65. A recent study and review by Sherrard et al. reports that CRCs often fail.[22] These authors found that many of the CRCs involved in poisoning episodes were defective, either through use or manufacture. McFee and Caraccio investigated 200 ingestions of prescription medications by children ≤6 years of age and concluded that CRCs afforded no protection in their population.[23] While it has been long recognized that many pediatric poisonings occur in spite of the presence of a CRC, this research suggests that we need to look more closely at the currently available products and how well they work in practice. Tenenbein in a recent article looked at the preventive effect of unit-dose packaging of iron supplements and found dramatic decreases in the number of poisonings and pediatric deaths from iron.[24]

In the area of parental education there is much past and ongoing research, most directed at childhood injuries in general, including poisoning. Several excellent reviews/meta analyses have appeared in recent years looking at this literature.[10,11,25-29] The general conclusions of these reviews are that parental education, either in the home, community or office, can increase parent's awareness and knowledge of poisoning, and may lead to the increased use of safety practices in the home. There is, however, little evidence that this translates into a true decrease in poisoning events, although very few studies have looked at poisoning rates as an outcome.[11] Another line of research has looked at parental and child predictors of child injury, including poisonings.[30-32] If these factors can be understood and readily assessed, they offer the possibility of directing intensified community efforts to those families most at risk. The WHO/Swedish model of integrated community-based injury prevention is being actively looked at worldwide as a possibly effective way to reduce injuries, including poisoning.[33-35]

Research Gaps

There is no recent research relating to the use and efficacy of currently available CRCs. Understanding the limitations of this technology could assist in strategies to increase their use and perhaps improve their design and performance.

There is also no published research evaluating a wide range of devices sold for home use in preventing childhood poisoning. These include cabinet and drawer locking devices, as well as containers for the storage of medicines and other toxins.

While there are many parent/child poison prevention educational materials available from various sources, there is no comparative research which might define the most effective messages and delivery methods. Particular emphasis should be placed on widely used materials such as *TIPP*® and an educational program distributed by the American Medical Association.[12,13]

Conclusions

It is clear that passive measures of poison prevention are more effective in younger children than are current educational programs. There is also good data that passive measures, even when available, often fail. The reasons for this are essentially unknown. Current research also suggests that most educational programs, even when coupled with the provision of safety equipment for home use do not result in a decreased rate of poisonings, although they have reduced mortality. We do not know the optimal method to affect parental behavior in ways that lead to a significant reduction in childhood poisoning. Data from Sweden suggest that comprehensive, community-based programs, coupled with local and national regulatory activity can lead to significant reductions in unintentional poisonings, as well as other unintentional injuries. Further research should be directed at gaining a better understanding of why our current methods of prevention do not lead to reduced rates of unintentional childhood poisoning.

Implications

Even though educational efforts have thus far not lead to major reductions in childhood poisoning, it is still incumbent on the medical profession and others involved with injury

prevention to continue to impress on parents their responsibility for close supervision of young children in the home and the need to take appropriate and practical measures to "poison proof" every child's living environment. The data clearly show that close supervision of young children in the home is a prerequisite for injury prevention. The Swedish model also suggests that it is important for communities to work together locally to identify problems within their community and institute potential community solutions. Governmental authorities must foster research into better passive preventive measures for childhood poisoning. This includes systematic evaluation of currently available devices and CRCs. Community level interventions are unlikely to effect changes in the rate of poisoning without improved passive methodologies.

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