Kidsafe ACT Incorporated

Button Battery Ingestion

An analysis of differences in injury severity outcomes between countries

A report funded by the Australian Competition and Consumer Commission
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Hunter – survived in Brisbane.
Ten operations and two years later he can eat normally

Summer – died in Brisbane, June 2013

Acknowledgements

Kidsafe would like to acknowledge the contribution and collaborative efforts of a wide range of organisations across a number of countries over the last two years in undertaking the work that has resulted in this report.

In particular we acknowledge the leadership exhibited by the battery industry and the involvement and support of the product safety regulators in all of the countries contacted. We acknowledge the Safe Kids Worldwide network member organisations, especially Safe Kids Worldwide, Safe Kids Germany, Safe Kids New Zealand and Safe Kids Austria, including the contribution of additional research into the likely causes of injury outcomes in Germany.

We acknowledge the various Kidsafe state and territory Associations and the local medical and research professionals across Australia who have supported our efforts to better understand these differences in injury outcomes and to develop effective injury prevention interventions for Australia.

The ACCC would like to thank the families of Hunter and Summer for permission to use their images on the front cover of this report.

Disclaimer

This research has been funded by the Australian Competition and Consumer Commission to help better understand the differences in the severity of injuries resulting from ingested button batteries that have been experienced in Germany and Austria compared to the experience in Australia, the USA and New Zealand.

As such, all suggested opportunities for action contained in this report reflect this focus on activities within the ACCC's sphere of influence in consumer product safety.

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1 Executive summary

This report arose from initial discussions during a workshop at the World Injury Conference in Wellington, New Zealand in September 2012 and subsequent follow-up discussions between Kidsafe in Australia, Safe Kids Germany and other Safe Kids Worldwide member country organisations, as well as the various Product Safety regulators and research organisations in our countries. The workshop identified that injury outcomes in Germany and Austria over the last decade or so have been substantially less severe than those experienced in Australia and the USA.

Kidsafe ACT was commissioned by the Australian Competition and Consumer Commission to survey a small number of parties in Australia, New Zealand and the USA and to compare their responses with similar surveys and additional limited research undertaken in Germany and Austria. Most of these groups had been involved in the original workshop discussions in Wellington in September 2012.

The limited objectives were to:

- improve our understanding of the causes of differences
- focus ongoing efforts and research, and
- inform ongoing interventions aimed at reducing the incidence and severity of button battery ingestion-related injuries to children.

1.1 Key findings

The following is a summary of some of the key points arising from the limited survey and research into differences between ingestion outcomes in Europe (Germany and Austria) and Australia/USA/ New Zealand.

- Button batteries have been recognised as a major environmental issue for over 25 years in Germany, originally as a result of concerns over the older mercury batteries. As a consequence, laws are in place requiring collection and destruction; and an extensive collection network is in supermarkets, etc.
- Most importantly, awareness at both community and health levels is very high in Germany and Austria and batteries are recognised and treated as dangerous. Although awareness levels have increased significantly in Australia since The Battery Controlled program started in 2012, the strength of the awareness of families and associated changes in behaviours are still markedly different between the countries.
- The Poisons Services (nine services located in Germany) are well coordinated and have firm protocols for advice on suspected battery ingestions—go straight to Emergency. Australian Poisons Services are similarly well-coordinated but appear to be accessed less for advice about battery ingestions than German Poisons Services. In any case, this is unlikely to contribute significantly to the injury outcome differences observed.
- Parents are much more likely to take a child to Emergency in Germany, rather than the local doctor. The timeframe for intervention is thus shorter in Germany and the system appears more likely to pick up possible ingestions early.
- Parental awareness is much greater. Thirty eight per cent of suspected ingestions in Berlin who were admitted to Paediatrics, had no sign of a battery at all, much higher than the Australian experience. If there is any doubt, a battery is assumed to be implicated. In Australia a child is only admitted and X-rayed if the doctor is satisfied that ingestion is implicated—as a result most admissions will in fact have a battery involved.
- Associated with this, in Australia doctors are loath to X-ray young children unless it is clear that they need to, because of the potential impact of x-rays on the young bodies.

- Multiple location diagnosis processes in Australia (through the extensive General Practice system that then refers patients to Emergency Departments at Hospitals) may increase the chance of missing the possibility of ingestion and increase the chain of events and timeline compared to presentation immediately to Emergency, as is the experience in Germany.
- The medical system in Germany and Austria as a whole also seems more aware of and focused on the risks of button batteries and the issues involved. All doctors in Germany have a Poisons Manual that includes specific material on this issue and doctors use it.

With 800 suspected cases of button battery ingestions reported to the Poisons Services alone in Germany each year, it does not seem that the rate of reported ingestions is much less than in the other countries reviewed. Children are still suspected of ingestion. However, comparison of these statistics is difficult as incidence data is relatively poor in Australia unless catastrophic injury occurs. Even then, diagnosis often occurs after the child leaves Emergency, so initial recording is likely to be non-specific.

We did not look closely at treatment, as there is no indication that this is any different once a child is confirmed to have ingested a battery. The key seems to be the time between ingestion and confirmation of the diagnosis. The system in Australia and the USA as a consequence needs to deal with more catastrophic injuries once ingestions are identified.

These finding should be considered within the limited objectives of the review. The survey recorded and compared the knowledge of staff from a variety of organisations. Additional specific research from Germany is included intact.

2 Objectives and background

2.1 Purpose

The purpose of this project was to collect the available data from a number of sources in each country, allowing an analysis that would identify differences in the environment or systems that are likely to be contributing to the different injury outcomes. The types of specific differences amongst the various countries we explored include:

- supervision of children around button batteries
- consumer awareness of button battery ingestion hazards
- early detection and treatment involving button battery ingestions
- causal factors (i.e. how and where did the children get the button battery).

This analysis will be used to inform ongoing actions.

2.2 Objectives of the review

This paper examines differences in the environments and systems within five countries (Australia, Germany, USA, Austria, New Zealand) that are likely to have resulted in the apparent differences being experienced in the reported incidence and severity of outcomes for children ingesting button batteries.

The aim was to consult regulators, community groups and the medical profession in the five countries and to help focus attention on the aspects of the environment and systems that might be reviewed to help improve injury outcomes for children quickly.

The objectives were to:

- record and compare the knowledge of staff from a variety of organisations
- understand the likely causes of the differences in injury outcomes
- focus any additional and more specific research in the future, and
- inform the development of interventions in Australia, the USA, and New Zealand.

2.3 Background

The urgency of this issue was again illustrated with the death in June 2013 of a toddler in Queensland, Australia, after ingesting a button battery and in October of a toddler in California, USA.

It became apparent during the workshop on this issue presented at the Wellington, NZ World Injury Conference in September 2012 that the outcomes for children ingesting button batteries in Germany (and possibly other European countries) were not as severe as the experience in the USA and Australia.

Subsequent discussions within Germany identified that there appear to be some 800 cases identified in the poisons reporting system each year, but these do not translate into the severe cases and deaths experienced in Australia and the USA.

It is recognised that these differences may be the result of a variety of potential differences between countries. Contributing factors to higher severity may include:

- differences in the level of awareness of the issue in the community and possibly the medical profession and the differences in behaviour that this awareness creates. In particular in some areas with little historical exposure to the issue, there may be a poor understanding of the actual cause/ reactions involved and the speed of deterioration in the child's condition

- poor evidence and limited reporting, especially because of the difficulties in diagnosis and delays between ingestion and a positive diagnosis. Once through the Emergency Department, documented reporting is difficult to source in some countries. Reporting of possible ingestions in countries that make greater use of local doctors for initial diagnosis is also less likely to be complete
- difficulty in diagnosing the presence of a button battery, especially as a significant proportion of ingestions occur in some countries when no one is present with the child. In Australia it is thought to be around 50%
- consequential differences in the level of delays and difficulties in diagnosis within the medical profession as a whole, especially where general practice doctors with limited individual exposure to the risk are the first response
- very complex outcomes and treatment options once the catastrophic effects are identified, and
- the short time span between ingestion and the onset of catastrophic damage to the child that can extend well after the battery is removed.

A number of possible causes were identified in Germany, and through discussions between Safe Kids Worldwide member country organisations, but there was no clear evidence to support any of these possible causes.

- Do more products have childproof compartments in Germany?
- Do parents still use keys more than remotes?
- Is direct supervision of young children more direct and intense at home?
- Is the first response medical care/ diagnosis different and/or more effective?
- Are parents more likely to go immediately to Emergency/Casualty, rather than a local doctor?
- Is there a focus or a tight process in Emergency that identifies ingestion more quickly (e.g. from a greater use of X-rays earlier in the diagnosis process)?

3 Methodology

The methodology provided for a number of specific questions to be researched in Germany (and the other countries) and for a junior researcher in Germany to collate the data involved from a number of sources. At the same time we collected similar feedback through Kidsafe in Canberra, Perth, Brisbane and Sydney.

The purpose of the methodology was to seek a coordinated response to a specific set of questions in each location from a limited number of sources that would help to identify the differences and thus point to the principal causes of the difference in outcomes.

After collecting similar data from Germany, Austria, Australia, the USA and NZ, we had the benefit of some key participants coming together to review the input and circumstances; and propose potential solutions to the key questions. We knew this was a difficult issue with no obvious single answer and a variety of attempts over the last nine months via emails, teleconferences and informal discussions, not providing a solution.

The work we had undertaken earlier indicated that the methodology would provide a realistic path forward.

3.1 Scope

In each country we spoke to a sample of hospitals; medical professions; poisons information services; and researchers involved in this area:

- Australia— Dr Ruth Barker in Qld; Prof David Forbes in WA; Dr Tony Lafferty in Canberra and Prof Danny Cass in Sydney were the starting points together with the research work already undertaken on the issue in Qld and WA.
- Germany—Dr Stephanie Marzheusar, the President of Safe Kids Germany in Berlin (Stephanie first raised the issue of German experience of lower severity in Wellington) and Martina Abel the CEO in Bonn co-ordinated the work in Germany. They have undertaken considerable effort in the major hospitals and Poisons Services, as well as a number of the German national Research Institutes.
- Austria—Grosse Schutzen Kleine (Safe Kids Austria) is physically located in a Safety House in the main children's hospital in Gras and has extensive connections with the medical system both in the Hospital (it operates a Bedside Counselling service there for parents in Paediatrics) and across Austria, and undertakes research as part of their work with the hospital system.
- USA—Safe Kids Worldwide is owned in the USA by the Children's National Medical Centre in Washington and has strong ties with John's Hopkins University, the CPSC and Health Resources and Services Administration. They have been undertaking an extensive program on button batteries through their 500 plus coalition partners (including a number of major children's hospitals) and have direct access to the National Capital Poisons Centre. The key contact group outside Safe Kids Worldwide have been members of the Button Battery Taskforce of the American Academy of Paediatrics.
- New Zealand—Safekids New Zealand is a service of Starship Children's Health, the major children's hospital in Auckland and has been heavily involved in the development of this issue with Trading Standards, the consumer protection unit of the Ministry of Business, Innovation and Employment (MBIE).

We developed a brief questionnaire. The content of the questionnaire was reviewed with Dr Ruth Barker and Prof David Forbes initially to make sure that it described the system in WA and QLD, the two Australian States with the greatest number of recent severe incidents, and allowed us to

make meaningful comparisons when feedback was obtained from the other locations. The responses from Germany, USA and New Zealand are included at Appendix B.

This questionnaire was then the basis of a single set of responses from each of the other countries. In Germany we also sought more specific feedback and research on the parts of the system that appear to provide the most likely explanation of differences.

A number of Safe Kids Worldwide network members met in Berlin, Germany, and Graz, Austria, and were able to review the emerging information. These people included Kate Carr, CEO of Safe Kids Worldwide; Dr Stephanie Marzheusar, President of Safe Kids Germany; Prof Sebastian van As, Chair of Childsafe South Africa; Mag. Dr. Peter Spitzer of Gross Schutzen Kleine (Safe Kids Austria); and Eric Chalmers, Kidsafe ACT Inc.

3.2 Systems involved

The core response systems that have been identified to date are:

- Hospital Emergency/ Casualty
- First response/General Practice medicine
- Poisons Services
- The relationship between these core response systems
- Data collection and dissemination within medical-related systems
- Medical care within the hospital system

Other systems that may impact on the incidence and severity include:

- recycling / disposal regimes
- consumer awareness structures
- parental supervision culture within the community
- product standards, both for children's products and more broadly and how they relate to availability of button batteries to young children.

3.3 Method

The key data has been obtained from unconnected sources and is largely secondary data and views about how systems operate in practice, etc. The methodology needed to be flexible and adjustable in the light of early outputs and was as follows.

- Preparation
  - agree the issues
  - develop the list of questions for each country to assess and respond to
  - obtain feedback on the list and collection methods
- Collection
  - collect feedback from countries in the form of single survey responses form the USA, New Zealand and Germany and individual feedback from four Australian states. Additional detailed feedback was also obtained from Germany
  - undertake initial review of content of responses to determine data quality and consistency
  - obtain clarification where needed and summarise responses
- Review
  - review input from Australian sources to develop an agreed summary
  - meet with Safe Kids Germany, Safe Kids Worldwide (USA) and Safe Kids Austria to review feedback in detail
  - develop initial set of likely outcomes and next steps

- Analysis
  - identify areas where analysis confirms linkage and potential solutions
  - develop action plans to advocate for implementation of these changes
  - identify potential for additional detailed research to improve outcomes
- Report
  - write report
  - review report with contributors
  - adjust report as required
  - submit final report
- Advocacy, etc.

We also subsequently sought additional feedback from SusySafe organisation based in Italy and from Spain, together with additional input from Child Safe in South Africa. The feedback from SusySafe in Italy and from Spain will be added when received.

4 Analysis

4.1 The issue

Button battery ingestions have a number of attributes that make them difficult to control and to reduce the potential for catastrophic outcomes.

- Batteries seem to be ingested relatively often and caught in the esophagus in a few instances.
- They can also be inserted into the nose, ear, eyelid, etc.
- They are often not noticed at the time of ingestion. In Australia this is thought to be as high as 50% of ingestions although hard data is unavailable.
- There are vague, common symptoms similar to colds/flu.
- A short timeframe is involved. Severe damage starts within two hours and can continue for some days after removal of the battery.
- The consequences are catastrophic, including severe permanent disability and death.

But – the experience in Germany and Austria is quite different. Although there are a significant number of potential cases reported, there have been none of the catastrophic injuries experienced in the USA and Australia.

4.2 The initial awareness program

In the USA Safe Kids Worldwide and Energizer implemented a consumer awareness campaign based on a website and distribution of flyers through the 500 plus Safe Kids Worldwide coalition partners.

This was supported by Energizer and included an initial five country consumer awareness survey funded by Energizer.

The Australian program has been based on the USA Program and funded by Energizer and the ACCC. It has been a joint ACCC / Kidsafe initiative.

The Australian Program comprised:

- joint media launch of the The Battery Controlled safety campaign
- a dedicated website – www.TheBatteryControlled.com.au - and associated social media via Kidsafe, Battery Controlled, ACCC and state and territory consumer protection agencies
- dedicated online alert site on the Product Safety Australia website www.productsafety.gov.au/batterycontrolled
- extensive distribution of fact card and poster through Kidsafe's community and medical network, Playgroup Australia and by the ACCC
- editorials in parenting magazines and online forums
- inclusion of button battery safety in ACCC's Product Safety Week 2013 and Safe Santa campaigns 2012 and 2013
- support from the Australian Family with inclusion of button battery safety posters across 3,500 child care centres across Australia and magazine advert on button battery safety sponsored by Energizer
- support from Mr Minit franchisees via in-store fact card distribution at point of purchase
- support from Woolworths via its print and online magazine
- outreach to the button battery industry to join the button battery safety campaign and raise consumer awareness via their customer networks .

Recent follow up research commissioned by the ACCC has shown a significant increase in overall awareness of the issue in Australia from 27% in the original Flieshmann survey by Energizer in 2011 to 72% in late 2013.

4.3 Countries consulted

The project has consulted a variety of people and organisations in the following countries:

- New Zealand
- USA
- Austria—Styria
- Germany— Berlin and Bonn
- SusySafe (Italy-based— covering 7 countries)
- Spain (through the ICPHSO Conference in Australia in October 2013)
- Australia— Perth ; Brisbane; Sydney; Canberra
- South Africa— Capetown

4.4 Participants

The organisations listed in Appendix A were consulted directly in collecting the data on individual countries. As was expected, no one source was able to completely respond to the survey and in all cases a significant portion of the response was anecdotal and based on the collective experience of the participants.

4.5 The situation in Germany

The core differences appear to arise from the historical approach to the environmental issues posed by mercury batteries in the 1980's and the overall approach subsequently supported for both increasing awareness and encouraging contact with the medical system in Germany and Austria.

- The concerns about small batteries arose in the 1980s as an environmental issue focused on problems with the mercury in mercury-based batteries.
- Germany subsequently put in place:
  - extensive awareness campaigns
  - supporting regulation and law
  - extensive collection systems for batteries, etc.
- Medical and consumer awareness is high:
  - consumers are 'paranoid' about the dangers of batteries
  - paediatricians all have a text— 'Poisoning in children'
  - most local stores have battery collection bins.
- No severe cases were identified in the last 20 years.
- The main issue for these batteries in Germany today is recognized as the lithium in the batteries, specifically the risk of explosion and the resulting exposure to the lithium.

4.6 Structural position in Germany

4.6.1 Awareness

There is very high consumer awareness of button batteries and batteries more generally, but the specific issue of ingestion has not occurred there. Consumers are highly aware, and referred to anecdotally by people from outside Germany as 'paranoid' about the issue. The health system is also strongly aware and able to act quickly on any potential ingestion.

This combination of concerns about the environmental issues associated with batteries and the existing high awareness have created a strong focus on the broader issue of batteries and their risks. As a result, whilst there is little awareness of the specific ingestion issue we have in Australia, the USA and New Zealand, the broader awareness, regulation and awareness seem to have negated the need to focus on the ingestion issue itself as we have to do.

4.6.2 Battery disposal structure

There are specific laws requiring people to collect and properly dispose of batteries, including button batteries. As part of this process, most retail stores have battery collection bins displayed in a prominent place in the front of the store.

4.6.3 Role of the Poisons Service

- The Poisons Services (nine separate services in Germany) have an important role as a first response structure.
- People use the service. About 800 potential ingestion cases are reported a year over the 9 services.
- If there is any possibility of ingestion, parents are sent straight to Hospital Emergency Departments with instructions to tell the staff immediately of their fears.

4.6.4 First response structure

- Families go straight to Emergency, rather than to local doctors.
- In Austria only about 10% of Emergency attendees are admitted, indicating that Emergency is treated as the first point of contact by many more families in Germany and Austria.
- Possible ingestions are treated immediately.
- In 38% of the Charite Hospital, Berlin cases reviewed with suspected ingestion no battery was found in the child.
- 48% had a battery in stomach/lower tract (or one had already been taken out).
- 14% had a battery in the oesophagus. The two with further treatment started surgery 3 hours after contact with hospital). No complications in any cases.

This structure in Germany, with many common attributes similar to Austria, is very different to that reported in Australia, the USA and New Zealand.

4.6.5 Treatment in hospital

The study has not considered differences in treatment once the battery is diagnosed. Our focus has been in the delays in diagnosis and the consequences of that on prognosis.

We are not equipped to comment on treatment and it has not been identified as a likely determinant of the different outcomes between the countries.

4.6.6 Equipment

In discussions in Austria, Child Safe from South Africa identified that:

- Cape Town, South Africa use a low intensity scanner
- the scanner was developed to scan miners in South Africa for contraband daily as they left a shift
- it identifies a wide range of issues quickly
- the scanner is low intensity, without the dangerous side-effects of X-ray
- cost of the equipment is not in the high expense range of MRI equipment.

This alternative might provide Health Systems with an alternative to the standard X-ray with its attendant concerns about the impact of X-rays on young children and the consequential move to restrict X-rays until demonstrably required.

5 Conclusions

The following comments relate to the contributory factors and possible causes identified in the Background Section.

5.1 Market for and use of lithium button batteries

Energizer has confirmed that the structure of the market for button batteries in the five countries being compared has no significant differences in the mix and types of batteries sold.

In particular, there is no evidence to suggest that people in Germany use lithium batteries any less than in the other countries.

5.2 Standards and Regulation

Battery compartments are locked under standards for children's toys but not generally for other goods sold for adult use. USA data also indicates that 62% of ingested batteries were obtained directly from the product, and another 30% were loose, sitting out or discarded.

USA studies also indicate that in 36% of cases the battery was intended for use in remote control devices; 13% for games and toys; 9% for watches and stopwatches; and 8% for flameless candles.

This confirms the importance of ensuring all battery compartments are properly locked to prevent the inadvertent access by young children. Regulatory changes in Australia to improve product labelling and to lock small batteries into all products, not only those used by children, could play a role.

However, whilst locked compartments may reduce the incidence of severe injury and death from ingestions (based on the USA research on the sources of batteries ingested by children there), it would not explain the absence of permanent injuries and deaths in Germany.

5.3 Collection and destruction

The German system has extensive controls over the collection and destruction of used batteries. This was a key action in the original drive in the 1980's, albeit for environmental reasons.

There are extensive collection structures (most retail store outlets have collection bins for batteries and other recyclable products). More importantly for our current discussion, it seems that this long-term focus on the danger of batteries generally has resulted in both high awareness of the dangers inherent in batteries and the transfer of this awareness into action, to:

- dispose of batteries properly
- keep batteries out of reach of young children, and
- be aware should any possible misuse be indicated.

The general position in the USA is that a disposal system would be costly to maintain, of limited value and may increase the level of unwanted batteries lying around the house.

Any drive to put a collection system in place in Australia would need to address these core issues of safe collection at home; broad distribution of collection points; and an effective, sustainable collection and destruction regime within the industry. Regulatory support, perhaps as part of existing recycling programs for larger batteries, may help to maintain the structure, but would not in itself resolve the issue. However, moves to develop a sustainable collection system for button batteries with Australian industry could help to raise consumer awareness of the issue.

Given the level of access of the Poisons Services in Germany and the level of reported possible ingestions, it also seems that the key to the differences is unlikely to lie in the collection of batteries, except to the extent that this reinforces the danger of batteries generally.

5.4 Community awareness and behaviour

There is no doubt that community awareness and awareness within the health system are both much higher in Germany and Austria.

More importantly it seems that in Germany this awareness has resulted over time in significant differences in supervisory behaviour and in the structure of the first response from both parents and the system.

We have already seen an increase in overall awareness in Australia from under 30% to over 70% in the last 18 months. We now need to translate this into a different first response reaction by parents and the need to increase the level of close supervision that would make a more timely response more likely.

This issue of awareness and its impact on behaviour is one area that should be reviewed in more detail with more specific research.

Existing Australian consumer and poisons awareness programs should be maintained and intensified to focus on longer-term behavioural change for carers and families as well as increasing immediate awareness of the risks.

5.5 First response structures

There seem to be significant differences in the first response structures of Australia and the USA relative to Germany and Austria. These differences could contribute to the greater level of severe injury observed in Australia and the USA. Lower levels of awareness in the community and the health system could also contribute to the difference.

The impact of these differences is heightened by the short timeframes available to make a positive diagnosis and the catastrophic consequences of delays that for most other injuries might not be significant.

People in Germany still observe possible ingestions, as evidenced by 800 calls a year to the 9 Poisons Services. The German services are trained to send the family straight to Emergency at a hospital. The response in other countries is not so clear.

The health system in Australia actively encourages parents to only use Emergency as a last resort and to go to the local General Practice doctor first. With only about 10% of attendees at Emergency being admitted in Austria and a similar level in Germany, there is a much greater use of Emergency as a first point of reference in these countries.

In a number of the severe injuries and deaths in Australia, the children have been taken to more than one local GP doctor, sometimes over some days, prior to being taken to Emergency. Because of the typical, somewhat indeterminate symptoms, a GP might be more likely to send a child home to wait for developments unless there is some clear indication that a battery is involved.

The following first response changes could be considered in future strategies:

- increased use of Poisons Service
- automatic referral to Hospital Emergency if ingestion is suspected
- GP education and referral immediately to Emergency
- review of Emergency response structures
- use of low energy scanning as an X-ray alternative if deemed practical.

5.6 Diagnosis, reporting and treatment

This research has been focusing on the way in which the child is observed, and introduced into the system. The availability of the batteries to children; small size of battery; short timeframe for making a correct diagnosis; and difficulty in identifying correct diagnosis from general symptoms are recognised as the most likely areas of action.

There is no suggestion that the treatment is in any way different once diagnosis is made.

On the other hand, reporting and statistics can create difficulties. The presence of a battery may not be recognised in Australia for some time, as indicated in recent severe cases. This may not be until after the patient leaves Emergency –after X-ray or the development of other more catastrophic symptoms.

The extensive use of local doctors by families in Australia also means that suspected ingestions, cases where the battery is present but dislodged, etc. are not likely to be picked up in the reporting system at all.

5.7 Lessons for broader injury prevention issues

This issue and research have provided positive feedback that has implications for the broader injury prevention imperative. These include:

- the importance of seeking broader international feedback when developing sustainable injury prevention interventions
- awareness needs to be accompanied by concrete support for changing behaviour
- interventions need to be sustainable
- the importance of partnerships between Government, industry and the community sector in creating the conditions for significant behaviour change
- the importance of a rapid first response to button battery ingestion is similar to other types of children's injury – for example, Dr. Fiona Wood, former Australian of the year, advocates that quick action to treat burns saves huge cost and damage and is pushing strongly for first aid training for all parents, as does Kidsafe
- the imperatives for reducing injuries to children more generally are:
  - immediate action by parents in response to an incident (both close supervision and knowledge). In particular, improved education of parents on actions that should be taken at the time of injury
  - identify what went wrong and document 'near misses'
  - provide support for parents to take action immediately and get to the right place quickly
  - the need for a speedy first response at the best location for the injury.

5.8 Research indicated

This research raises the following questions that may be worthy of further investigation:

- The impact of cultural differences in planning and implementing prevention strategies. The data collected to date was not able to provide feedback on differences in culture and attitudes between countries and the impact that these differences are likely to have on behaviour.
- Comparison of differences between consumer behaviours in supervising children in Germany and the USA/ Australia.
- Comparable data on button battery incidents; how data is sourced; and gaps in the availability of data. The research may also provide helpful insight into data issues with larger injury and product issues that have less limited time constraints before catastrophic injury occurs.
- More detailed information on the working of the German battery collection system, in particular how batteries reach the collection system without children gaining access and the management of costs associated with the system.

Appendix A—Organisations consulted

Germany

- Safe Kids Germany
- Poisons Services
- Charite Virchow Hospital, Berlin
- BfR (Federal Institute for Risk Assessment)
- Stiftung Warentest
- DIN (German Institute of Standardisation)
- BAuA (Federal Institute for Occupational Safety and Health)

Austria

- Grosse Schutzen Kleine
- Children's Hospital at the Medical University of Graz

USA

- Safe Kids Worldwide
- Button Battery Task Force, American Academy of Pediatrics
- Children's Hospital of Philadelphia
- Nationwide Children's Hospital and Wexner Medical Center at Ohio State University
- Ann & Robert H Lurie Children's Hospital of Chicago
- Children's National Medical Centre, Washington, DC

New Zealand

- Safekids New Zealand
- Starship Children's Hospital
- Trading Standards

South Africa

- Child Safe (Safe Kids South Africa)

Australia

Queensland

- Kidsafe Qld
- Queensland Injury Surveillance Unit

Western Australia

- Kidsafe WA
- Princess Margaret Hospital

New South Wales

- Westmead Children's Hospital

Australian Capital Territory

- Australian Competition and Consumer Commission
- Canberra Hospital
- Kidsafe ACT

Appendix B—Survey Results

Germany

This survey was completed by Martina Abel of Safe Kids Germany to summarise the input obtained in Germany.

Respondent

1. **Please indicate which jurisdiction you are responding for (e.g. Queensland, Australia); your role within that jurisdiction; and other organisations you have consulted in responding**

Martina Abel, Safe Kids Germany, National Non-Governmental Organisation (Registered Society)

Consultancy of:

Poison Control Centre Bonn (North Rhine-Westphalia), Dr. Carola Seidel

Poison Control Centre Berlin (Berlin-Brandenburg), Daniela Acquarone

Charité University Hospital Berlin, Otto Heubner-Center for Paediatric and Youth Medicine, Dr. Stefanie Märzheuser, Caria Schneider

Federal Institute for Risk Assessment, Prof. Dr. Matthias Greiner, Dr. Axel Hahn

Stiftung Warentest, Dr. Silvia Pleschka

DIN (German Institute for Standardisation) Andreas Zause

BAuA (Federal Institute for Occupational Safety and Health), Dr. Matthias Honnacker

Product

2. **What is the prevalence of batteries in your jurisdiction in products and homes**

(including larger batteries)

- What proportion of TV remotes in households would have a button battery

Most TV remotes have torch batteries. In Germany button batteries are used mainly in scales, in clocks, in hearing devices, in car keys, in greeting cards.

- Estimate how many products would have a button battery in an average household

In 2006 in Germany 176 Million button batteries were sold. We had 39.767.000 households then. That makes a bit more than four button batteries per household. Regarding Lithium coin batteries 43 Million were sold.

- Estimate how many products would have >20mm button batteries
  Note: We are separately seeking feedback on the battery market structures in each of the countries from Energizer as a market leader

Estimation not feasible as too many different products might be involved.

In scales bigger coin batteries are very common, also in car keys (but not accessible for children at all) see list in attachment 1.

3. **Thinking of products that are potentially accessible to children please indicate what proportion of each product group (in your jurisdiction) have battery compartments that**

are child resistant (i.e. require a tool or coordinated double manoeuvre to open the battery compartment)?

- Toys: 100% child resistant compartments.

  The European Toy Directive: Toys for children up to the age of 36 months must be designed in the way that there are no small parts which can be swallowed. Toys which can be hazardous for children younger than 3 years old must be branded with a specific symbol.

  DIN EN 71 (Safety of Toys Standard, Norm): Battery compartments have to be made in the way, that they cannot be opened without using a tool, e.g. locked by screws or other mechanisms

- Toys for children over 36 months

  The same: The DIN EN 71 addresses children up to the age of 14.

- Everyday small household items (i.e. car keys, remote controls, torches)

  The European Product Safety Directive, and the German Product Safety Law: Products must be constructed in a way, that they do not cause health hazards. They have to meet the state of technical knowledge.

  In most products batteries are in compartments which cannot be opened easily. Not in the way that you always need a tool (such as in toys) but that there is a barrier for access (not feasible for a child younger than 3).

- More expensive household items (i.e. cameras)

  See above.

- Novelty items (i.e. singing cards, flashing jewellery, tea lights)

  Here we do not overview the market, but we see that singing cards have no child resistant battery keeping.

4. **In your jurisdiction, what standards require battery compartments to be child resistant and how are these enforced (legislated/ mandatory standards, industry requirements)**

   All standards which relate to toys require battery compartments to be child resistant. They are mandatory to manufacturers, importers and traders. They are controlled by the market surveillance authorities.

5. **Considering button batteries, how are these available for purchase by the consumer? (tick all that apply and indicate where this sale might occur)**

   Sold individually unpackaged?
   Yes, on flea markets.

   Sold individually but packaged?
   Yes, in drug stores, electronic shops, building centers, department stores, stationery shops.

   Sold in multiples unpackaged?
   No.

   Sold in multiples but individually packaged?
   Yes, in drug stores, electronic shops, building centers, department stores, stationery shops.

   Sold in multiples but group packaged?
   Yes, in drug stores, electronic shops, building centers, department stores, stationery shops.

6. **Considering button batteries, what type of button battery is most prevalent in the market place? Does this depend on the product type (see question 2) or the source country? (Please comment)**

   Zinc-Air-button batteries: 59 Mio. pieces,

   Lithium button batteries 43 Mio. pieces,

   Alkali-Mangan button batteries 41 Mio. pieces,

   and Silver oxide button batteries 28 Mio. pieces.

7. **Are there regulations in your jurisdiction that require internationally manufactured / distributed products that use button batteries to be adjusted for your local market?**

   Yes. All products which are imported into the European Union must meet the requirements of the EU-Legislation. They can only get the CE-label (Communeaute Europeene) if the producer declares that the product is compatible with European regulations. The CE label is obligate for products which will be introduced on the European market.

Community

8. **In your jurisdiction, how would you rate the overall community awareness of button batteries as a hazard?**

   High

9. **Please comment on the level of direct supervision of children at home.**

- This may relate to house sizes; methods of supervision; use of hired help or day care arrangements; extent of dual income families, etc.

  Direct supervision is high in the home setting across most households (in general as most parents in Germany are very protective).

  Direct supervision is variable ranging from high to low across households (in groups with lower socio-economic status things might vary very much).

  Young children spend much of their time in a regulated environment (day care/child care/kindergarten) averaging 5 hours per day.

  Note: This is likely to be difficult and very subjective. Do you have a rate in your jurisdiction for some other better coded injury types are that relate to home supervision?

10. **What community-based battery collection systems are in place and how are families to collect, save and deliver spent batteries?**

    Rules for the collection of batteries are defined in the German 'Batteriegesetz' (Battery Law) **http://www.gesetze-im-internet.de/bundesrecht/battg/gesamt.pdf**

    Every distributor of batteries is obligated to take back and recycle the batteries.

Medical system

11. **How does the primary care medical system work in your jurisdiction?**

- Do families have access to a Poisons Information service?

  Yes. In Germany we have 9 Poison Control Centers accessible to everybody. The phone numbers are known by more and more parents. Safe Kids Germany is informing very broadly about the numbers.

- If so, how likely are families to contact the Poisons Information service if they suspect ingestion?

Estimation: 50 % will call the poison control center. 30 % will go to the Emergency Department of a hospital. 10% will go to the resident pediatrician. 10 % will do nothing.

- If the Poisons Information service were called about a button battery exposure, would the family be referred to a primary care provider or an Emergency Department.

  Yes. Definitively.

- Do families have to attend a local doctor first or are they able to go straight to an Emergency Department?

  They are able to go straight to an Emergency Department.

- Do families have access to same day appointments with primary care practitioners (GPs)?

  Sure. In Germany you can go to a resident paediatrician every day.

- If attending an Emergency Department, are children seen by junior doctors primarily?

  Maybe, but they will be well informed about button batteries. And they will consult a senior doctor if necessary.

- If attending an Emergency Department, are children seen initially by a generalist (emergency staff) or subspecialist service (e.g. directly seen by gastroenterology subspecialist if having difficulty swallowing)**?**

  Maybe, but it will not make a difference as different doctors all will have the same information about button battery treatment. There is an agreement initiated by the poison control centers about Xraying.

12. **What is the level of awareness of button battery-related injury amongst different areas of the health system? Primary care practitioners/ General Practitioners (GPs)**

    For General emergency staff and

    Subspecialty staff (Ear Nose and Throat, gastroenterology, surgical)

    The level of awareness for each group is High

13. **Is there a difference in level of awareness about button battery-related injury between medical staff that treat all ages versus medical staff that treat children only?**

    Higher awareness of staff that treat children. Part of the education of paediatricians and nurses.

14. **Is there a difference in level of awareness about button battery-related injury between junior and senior medical staff?**

    Senior staff are better informed.

General

15. **Please provide feedback on the value of this questionnaire, and changes that should be made for follow-up feedback.**

    No changes necessary.

16. **Please add other aspects, evidence, concerns or questions on this issue that you consider should be investigated more formally and the most appropriate group to do so.**

    You could add if the poison control centers have an agreement or a standardised paper how to monitor and treat button battery ingestion. In Germany the poison control centers try to set up general plans for all kinds of poisoning.

USA

The USA response was provided by Dr Kris Jatana as representative of the USA response.

Product

1. **Do more or less products have childproof compartments? This applies not just to children's toys, but to battery compartment generally.**

   Children's toys are more highly regulated and have had childproof compartments for some time, but until recently, other products that contain button batteries were not consistently utilizing more secure compartments. See below for further discussion regarding this.

2. **What are the parameters / protocols under which battery compartments are set in Standards?**

   The product standards industry is another avenue for major product safety testing and certification. Companies such as Intertek® and Underwriters Laboratories (UL) will determine the root cause of product injuries by analyzing products for design flaws, child behaviour patterns and consumer behaviour and make safety recommendations. In addition, the majority of batteries ingested have been obtained directly from products so safer compartment design could provide the single most effective intervention to mitigate injury. UL, of the product standards industry along with the American National Standards Institute (ANSI), has also addressed this issue with ANSI/UL 60065: Standard for Audio, Visual, and Similar Electronic Apparatus-Safety Requirement. The button battery must be contained and a tool or a minimum of 2 simultaneous independent movements required to gain access to it. This standard obtained consensus in April 2012 and mandatory compliance is effective in January 2014. A newer standard with broader scope, ANSI/UL 4200A: Standard for Safety for Products Incorporating Button Cell Batteries of Lithium and Similar Technologies, is currently under development. The proposed product requirements also include abuse and stress testing, as well as battery replacement testing. These requirements will be American National Standards-applicable to electronic devices supporting safe design principles.

3. **What types /configurations of batteries are typically sold/ used in products?**

   While hearing aid batteries lead the list when all battery sizes are considered (31% of ingested batteries reported to NBIH from Jul 2010–Jun 2012), these batteries are smaller (7.9 or 5.8 mm in diameter), and thus pose a risk of nasal cavity or ear canal insertion, but much less risk when swallowed. In contrast, during this same period, the most common intended use of ingested 20 mm lithium cells was remote control devices, implicated in 36.2% of cases, and not surprisingly readily-accessible to young children. Other ingested 20 mm lithium cells were intended for games and toys (13.1%), watches and stopwatches (8.5%), flameless candles (7.7%, ironically this 'safer candle' introduces another hazard), bathroom and kitchen scales (3.8), and key fobs (3.1%). Less common uses remind us that these dangerous batteries are everywhere, as evidenced by ingestions of 20 mm lithium batteries intended for book lights, calculators, garage door openers, glucometers, talking books, timers, lighted jewelry, digital thermometers, music players, and cameras.

4. **Are internationally manufactured/ distributed products that use button batteries adjusted for the local market?**

   This is a potential loop-hole as people (consumers) who go overboard, buy products, can bring them into United States circulation.

   To my knowledge, there are no governmental laws that enforce button battery standards. Attempts were made with the *Button Battery Safety Act of 2011* but it failed to make it out of Senate Subcommittee. Internationally manufactured electronics that contain button batteries may not incorporate the voluntary standards set for electronics from organizations like Underwriters Laboratories (UL). There is no government regulation or

mandate, but voluntary compliance is encouraged. Companies and the stores that sell such products assume some liability if they choose to sell such products.

Globally, we need to work together to set product safety standards at international level.

Community

5. **Do parents use remotes, etc. that require button batteries more or less?**

   Parents use remotes that contain button batteries more than in the past. There has been a shift toward slimmer product designs that use AA and AAA batteries less (safer batteries less).

6. **Is direct supervision of children at home more or less intense? This may relate to house sizes; methods of supervision; use of hired help or day care arrangements; extent of dual income families, etc.**

   There is frequently direct supervision of children in the home setting, however, ingestions have occurred even when supervision is present. These batteries are small and the caregiver does not always notice the ingestion event. Supervision may be parents/family members, but may also consist of babysitters, nannies, or day care centers.

7. **How are families encouraged to dispose of batteries?**

   Families are encouraged to disposed of used button batteries immediately as ‘spent’ batteries can still cause injury inside the body.

8. **What community-based battery collection systems are in place and how are families to collect, save and deliver spent batteries?**

   There are community-based battery disposal opportunities, but it does require families to collect and deliver them. This is less commonly used. Most consumers end up throwing them away in the trash.

Medical system

9. **How does the first response medical system work?**

Do families attend a local doctor first or go straight to Emergency/ Casualty?
What are the waiting times for access to a local doctor
What are the waiting times for attention at Emergency/ Casualty?

   Children may see their primary care physician or go to Emergency room with non-specific symptoms depending on severity. Children can usually get access to their paediatrician the same day during daytime hours. The Emergency room is available 24/7 but wait times can vary before child is seen. Wait times could range from no wait to 2-6 hours to be seen in the Emergency room.

10. **Are local family doctors likely to identify a correct diagnosis? What is it about the process they use that make diagnosis at this stage more or less likely? (e.g. doctors are specifically made aware of this danger and encouraged to look for possible lodgement, or are they generally unaware of the dangers and consequences?)**

    Medical professionals cannot look at a child with non-specific symptoms and consistently determine who needs an x-ray to make diagnosis of button battery ingestion. Many of these events are not witnessed. Moreover, not all paediatricians, emergency room physicians, family physicians, or even radiologists make the diagnosis by looking at the x-ray which can lead to delay in diagnosis and prompt treatment. The awareness over past few years has grown, and it is our hope that it will be routinely included in the medical education system in the future.

Casualty / Emergency response

11. How are young children treated on arrival? Are they fast-tracted? What is the average waiting time for toddlers and young children?

If a known button battery ingestion occurs, these children are moved quickly through the system, including a helicopter flight to a paediatric facility, if needed, and the receiving institution has been alerted about the planned arrival. The goal is to have the surgeon and surgical staff immediately available when the child arrives to get them to the OR for removal of the button battery. When the diagnosis is NOT known, the waiting time can vary during different times of year in the emergency room setting, so children who do not yet have a diagnosis (unwitnessed) ingestion and non-specific symptoms, may wait 2–6 hours before being seen by an emergency room physician.

12. Is it more or less likely to include an X-ray early in the process?

For a known ingestion, an x-ray is obtained as quickly as possible. If it is not known that the child has ingested a battery, then an x-ray is not usually obtained early. Non-specific symptoms such as irritability, fever, poor oral intake, vomiting, are present with many common viral illnesses in children and x-rays are not routinely done in this situation.

13. How are inconclusive, generalised symptoms treated at the diagnosis stage?

Generalised symptoms are usually treated conservatively, using symptomatic treatment such as Tylenol or ibuprofen when a viral illness is suspected. X-rays are not always obtained early due to concerns of minimising radiation exposure to children.

14. How are doubtful / complex diagnosis cases treated?

Complex cases where the battery has caused complications usually bring in more specialists to provide input, such as otolaryngologists, pediatric surgeons, gastroenterologists, etc. Some children require major surgery to repair injury, others may require G-tube or tracheostomy tube.

15. Is there anything in the way young children are diagnosed, treated, discharged that might shed light on the differences?

The symptoms are non-specific when an unwitnessed ingestion occurs, so this leads to delay in diagnosis. Without making the correct diagnosis, the proper treatment (battery removal) cannot follow. Not every child that has generalised symptoms of viral illness need to be exposed to radiation of x-ray, and rather, all efforts should be focus on increasing awareness of this problem, and prevention of the underlying problem—preventing access to the battery, or changing the battery design so injury can't occur when trapped in the body.

New Zealand

The following response has been put together based on dialogue between Starship Children's Hospital, Safekids New Zealand and the Trading Standards, the consumer protection unit of the Ministry of Business, Innovation and Employment (MBIE).Responding to the questionnaire was difficult as there is an absence of reliable data and information in New Zealand. There is also a significant subjective element to the questions so caution needs to be exercised around inter-jurisdictional comparisons etc.

The responses should therefore be treated with some caution as being estimated rather than factual.

The actual responses are shown below.

With regard to the draft warning suggest by Trisha Williams of Energizer -

WARNING: (1) KEEP OUT OF REACH OF CHILDREN. Swallowing may lead to serious injury or death in as little as 2 hours due to chemical burns and potential perforation of the esophagus.

Immediately go to the nearest medical emergency department. Keep in original package until ready to use. Dispose of used batteries immediately. (2) Risk of injury due to fire, explosion or leakage. Do not disassemble, charge, crush or expose to fire or high temperatures.

We would offer the following suggestions

- Line two, insert words 'or inserting' after 'Swallowing'. Text to read: 'Swallowing or inserting may lead to...'
- Line four, insert word 'hospital', before medical. Text to read: 'Immediately go the nearest hospital medical emergency department.'
- If the inclusion of the words 'or inserting' then there will need to be a later reference to change needed to 'perforation of the oesophagus'. Insertions in the nose for example can result in perforations of the septum. So maybe we should say something along the lines of: 'Swallowing or insertion into the nose or elsewhere may lead to death in as little as 2 hours due to chemical burns. Serious injuries can also result such as the potential perforation of the oesophagus.'
- We wonder too whether parents and caregivers would know what the oesophagus was - should maybe there is a need to use more 'everyday language'? For example: 'Swallowing or insertion into the nose or elsewhere may lead to death or serious injuries in as little as 2 hours due to chemical burns.'

Respondent

1. Please indicate which jurisdiction you are responding for (e.g. Queensland, Australia); your role within that jurisdiction; and other organisations you have consulted in responding

New Zealand

This response was compiled jointly by Starship Children's Hospital, Safekids New Zealand and Trading Standards, the consumer protection unit of the Ministry of Business, Innovation and Employment (MBIE)

Product

2. What is the prevalence of batteries in your jurisdiction in products and homes (including larger batteries)

This is very difficult to estimate in New Zealand. Most houses have many products that use batteries of all sizes, including (but not limited to) television remotes, stereo remotes, children's toys, computer mice, kitchen appliances, calculators, torches etc.

It is difficult to estimate the extent of 'exposure to battery-related risks', without more information on battery market structures. However, it is possible that exposure to risk may be varied by household deprivation, that is, households that experience greater rates of economic deprivation may have less exposure to battery operated objects. Further information would be required to test this assumption.

The following are estimates only:

What proportion of TV remotes in households would have a button battery

20%

Estimate how many products would have a button battery in an average household

4

Estimate how many products would have >20mm button batteries

1

Note: We are separately seeking feedback on the battery market structures in each of the countries from Energizer as a market leader.

3. **Thinking of products that are potentially accessible to children please indicate what proportion of each product group (in your jurisdiction) have battery compartments that are child resistant (i.e. require a tool or coordinated double manoeuvre to open the battery compartment)?**

   Toys for children under the age of 36 months - The majority if not 100% would have secure battery compartments.

   Toys for children over 36 months – as above.

   Everyday small household items (i.e. car keys, remote controls, torches) - <25%

   More expensive household items (i.e. cameras) - <25%

   Novelty items (i.e. singing cards, flashing jewellery, tea lights) - 0%

4. **In your jurisdiction, what standards require battery compartments to be child resistant and how are these enforced (legislated/ mandatory standards, industry requirements)**

   No mandatory standards at present but AS/NZS ISO 8124 Toy safety standard has requirements for child resistant battery compartments on toys which appear to be adhered to on a voluntary basis.

5. **Considering button batteries, how are these available for purchase by the consumer? (tick all that apply and indicate where this sale might occur)**

   Sold individually unpackaged—No evidence this occurs

   Sold individually but packaged— Yes

   Sold in multiples unpackaged— No evidence this occurs

   Sold in multiples but individually packaged— Yes

   Sold in multiples but group packaged— Yes

6. **Considering button batteries, what type of button battery is most prevalent in the market place? Does this depend on the product type (see question 2) or the source country? (Please comment)**

   Lithium
   Mercury
   Alkaline

   Difficult to gauge but the impression would be that lithium would form the main type

7. **Are there regulations in your jurisdiction that require internationally manufactured / distributed products that use button batteries to be adjusted for your local market?**

   No—nothing with this effect in place. Being a small economy it is unlikely that New Zealand would put such a requirement in place.

Community

8. **In your jurisdiction, how would you rate the overall community awareness of button batteries as a hazard?**

   Low—there have been media articles and publicity/information released on the issues but the feeling is that the awareness level is still overall low.

9. **Please comment on the level of direct supervision of children at home.**

Difficult to see what this question adds? Exposure to risk of battery injury may (or may not) be related to patterns of supervision – the numbers in NZ are too small to come to any reliable or robust conclusions. Data on patterns of supervision of children can be found here

http://www.stats.govt.nz/browse_for_stats/people_and_communities/time_use/caring-for-children.aspx

This may relate to house sizes; methods of supervision; use of hired help or day care arrangements; extent of dual income families, etc.

Very hard to answer given there is no definition of 'direct supervision' or clarity around what 'high' is compared with 'low' but the following is offered as a best attempt at a response:

Direct supervision is high in the home setting across most households—No

Direct supervision is variable ranging from high to low across households—Yes

Young children spend much of their time in a regulated environment (day care/ child care/ kindergarten)—No

Note: This is likely to be difficult and very subjective.

Do you have a rate in your jurisdiction for some other better coded injury types are that relate to home supervision?

No

10. What community-based battery collection systems are in place and how are families to collect, save and deliver spent batteries?

None but the concept has been discussed and the NZ Retailers Association has raised the issue with their members. This may see a pilot initiative being undertaken to test out whether such a scheme would have any value.

Medical system

11. How does the primary care medical system work in your jurisdiction?

The following four answers were completed by Dr Mike Shepherd of Starship Children's Hospital

Do families have access to a Poisons Information service?
Yes—the National Poisons Centre

If so, how likely are families to contact the Poisons Information service if they suspect ingestion?
Low probability directly—awareness of the facility will vary and whether the NPC covered battery ingestion issues

If the Poisons Information service were called about a button battery exposure, would the family be referred to a primary care provider or an Emergency Department
Not sure—would need to discuss with the National Poisons Centre

Do families have to attend a local doctor first or are they able to go straight to an Emergency Department?
Families can come directly to an Emerge

Do families have access to same day appointments with primary care practitioners (GPs)?
Yes

If attending an Emergency Department, are children seen by junior doctors primarily?
This is often the case

If attending an Emergency Department, are children seen initially by a generalist (emergency staff) or subspecialist service (e.g. directly seen by gastroenterology subspecialist if having difficulty swallowing)?
Generalist

12. **What is the level of awareness of button battery-related injury amongst different areas of the health system?**

    Primary care practitioners/ General Practitioners (GPs)—
    Moderate

    General emergency staff—
    Moderate

    Subspecialty staff (Ear Nose and Throat, gastroenterology, surgical)—
    High

13. **Is there a difference in level of awareness about button battery-related injury between medical staff that treat all ages versus medical staff that treat children only?**

    Yes

14. **Is there a difference in level of awareness about button battery-related injury between junior and senior medical staff?**

    Probably greater among senior medical staff

Australia

Because of the extensive scope of discussions across Australia and the close proximity of key respondents to our work, a separate survey was not completed for Australia as a whole.

Appendix C - Case studies

Case studies of button-battery-ingestions at pediatric clinic Charité Virchow from 2010/01/01 to 2013/08/31

Number of cases

2010 - 7 cases

2011 - 9 cases

2012 - 9 cases

till 2013/08/31 - 4 cases

Overall we had 29 cases in this period of time, on an average of approximately 8 cases per year.

Severity and outcomes

(a) cases with no prove of ingestion

In 11 cases (38%) the parents supposed an ingestion but there was no detection of a battery in X-Ray (or in 1 case: instead of X-Ray the parents were told to control the stool until the next day).

(b) button battery located in stomach/ lower gastrointestinal tract, no endoscopic intervention

There were 11 cases (38%) with X-ray-detection of a button battery in the stomach or lower gastrointestinal tract with no indication of endoscopic removal. A second X-Ray for progress control was done in 6 cases, 3 children stayed at in-patient department for observation (in one of these cases ingestion of a 20mm-button-battery was described). These patients had no symptoms or complications (in 1 case parents described dark stool the second day post ingestionem but with no diagnostic prove of melaena or blood loss)

(c) button battery located in stomach/ lower gastrointestinal tract, indication of endoscopic intervention 3 cases (10 %)

Case 1

10-year-old baby with X-Ray detection of button battery in the stomach. The endoscopic removal was done the same day post ingestionem without complications (surgery started 11h 45min after contact with medical staff).

Case 2

2-years-11months-old boy with X-Ray-detection of button battery presumably in the stomach. The same day endoscopic intervention was done. The removal of the battery was unsuccessful because the battery was already located in duodenum at this point of time. There were no complications during the passage of the battery through the gastrointestinal tract. (surgery started 4h after contact with medical staff).

Case 3

11-months-old baby, X-Ray proved the presence of two button batteries in the stomach. The endoscopic intervention started 2.,5 hours after contact with medical staff in emergency department. One of the batteries remained in duodenum. There occurred no complications. (surgery started 2h 30min after contact with medical staff).

d) battery located in oesophagus, endoscopic intervention, no further complications or treatments 2 Fälle (7 %)

Case 4

1-year-old girl, transfer from DRK-hospital in the morning after ingestion of a button battery the evening before. X-Ray showed the battery located in the upper part of oesophagus. During endoscopic removal (at 7 am) a lesion of the esophagus mucosa in the contact area of the battery was seen. The girl stayed in intensive care for one day. Because of the stable state soon extubation was possible. Day 40 post ingestionem a control oesophagogastroscopy showed a nonirritated foveal healing process without indication of dilatation. There were no complications.

Case 5

6-year-old girl with mental retardation and status post multiple OMS-surgeries. Transfer from hospital Pritzwalk day 1 post ingestionem and after signs of hypersalivation, dysphagia, regurgitation of multiple peanuts. Endoscopic extraction of the peanuts and the button battery which had clear signs of corrosion, but was intact. There were two dot-shaped pale superficial marks at the mucosa of the middle part of oesophagus. The ventilation was assisted for 38 hours, afterwards the girl showed transient hypertension. There were no further complications. (surgery started 1h 20min after contact with medical staff).

e) battery in oesophagus, endoscopic intervention, following treatment (dilatation) neccessary

2 cases (7 %)

Case 6

11-year-old baby with ingestion of a ’modern lithium battery‘, initially presenting hypersalivation. X-ray showed the button battery in the upper narrowness of oesophagus/ pharynx. The removal was possible with Magill‘s forceps. Endoscopic control showed massive coagulation necrosis involving three quarters of the circumference of oesophagus with no perforation. Afterwards there were no complications and no dysphagia. An oesophagogastroscopy control at day 10 post ingestionem showed evidence of deposits and an indication to dilatate. control at day 33 post ingestionem showed a result of intact slight foveal mucosa without stenosis. There occurred no further complications or impairments. (surgery started 3h after contact with medical staff)

Case 7

1-year-old girl after ingestion of a presumable 20 mm-lithium-battery (‘size of 1-Euro-coin’) with symptoms of hypersalivation, multiple vomiting, refusal of food and liquids. The button battery was detected in the middle part of oesophagus. The findings during endoscopic removal were a leakage of blackish liquid from the battery and inflamed mucosa with extension of circa 2 cm in the area of the upper oesophagus. In the further process the girl showed regressive fever peaks. day 10 post ingestionem the oesophagogastroscopic control showed nekrosis 12 cm from teeth with no stenosis. oesophagogastroscopy day 17 post ingestionem found white deposits in the known place with a slight luminal constriction. Dilatation was done with Cook-Bougie from 5 to 9 Charr. There were no complications in the further progress. (surgery started 3h after contact with medical staff).

Overall in the considered lapse of time (3 years, 8 months) there occurred no cases with severe outcomes or long-time impaiments like esophageal perforations, tracheoesophageal fistulas, exsanguination, long-time or recurrent esophageal strictures, vocal cord paralysis or others. In only 4 cases (14%) button battery was located in esophagus, a fact that presumably correlates to the ingested types and sizes of button batteries. Unfortunately the battery types of the extracted batteries were hardly documented. In one of the 4 cases there is evidence of a ‘modern lithium-battery’, in another case there is a hint of a 20-mm-battery. Respecting the last case the leakage of battery liquid is documented. In the further process these two cases showed partially stenosing cicatrization, which required a single further dilatation by bougie. Further treatments were not neccessary and there also occurred no complications.

Further information

age (years)	number of cases of (presumable) ingestion	percentage
0-1	4	(14,8%)
1-2	12	(41,4%)
2-3	8	(27,6%)
3-4	1	(3,4%)
4-5	2	(6,9%)
>5	2	(6,9%)

Information on the circumstances of ingestion

Ingestion was stated to be assured during anamnesis in 12 cases, while the ingestion was presumed/ not observed in 17 times.

Source of the battery: In 2 cases the batteries derived from the package, in 2 cases from toys (in 1 case the battery coverage of the toy was removed), in 1 case from a flashlight. In the other cases no origin of the ingested battery is documented.

Conduct after ingestion: It was not possible to find information in the medical documentation about contacting the poison control center from the parents or the medical staff after ingestion or during the treatment.

Two times children were transferred from other clinics for endoscopic treatment. One case documented the consultation of a resident pediatrician which arranged the transfer to emergency department. At an exceeding amount of the cases the parents seemed to present with their children directly in emergency department.

Time lapse between ingestion and medical contact in emergency department: There are 8 cases with documented times of ingestions, after which parents consulted medical help in the emergency department the same day. In these cases the times between ingestion and generation of the first aid document by the physician in charge ranged between 40 minutes to 2 hours 20 minutes, on an average of 1 hour 10 minutes. In 5 cases the consultation took place the day after ingestion, in one case two days respectively 4 days post ingestionem.

Appendix D – Meeting notes
Federal Institute of Risk Assessment.

Note: This was the key meeting in Germany with the Institute responsible for the research into safety of products in Germany. It holds the history of work in this field.

Button Battery Discussion in the Federal Institute of Risk Assessment Berlin

Welcome from Prof. Dr. Matthias Greiner

Prof. Greiner gives information about the Federal Institute of Risk Assessment

Dr. Hahn about the Monitoring System in Germany:

FIRA report every 2 years, cowork with the 9 Poison Information Centers that exist in Germany. Legislation in Germany in this area is based on the chemical‘s law, which provides information from the Poison Centers to the Institute (mostly inquiries). Besides there is also a law that all the physicians/hospitals which treat poisoning within children report information to the Institute (moderate cases). The commitee for Poisoning is similar to the one in the US. The national data system of the US provides more information and cases, the system in Germany contains more details on the cases and involved products.

Eric Chalmers: *Type* (Lithium) and *size* play a role. batteries need only 1.3 V to start reaction in esophagus. This is part of the data collection process, aquiring the data is very difficult. Most problems exist in West Australia and Queensland because of the distances to hospital.

Hahn: It had been a problem in Germany some decades ago. in the 80s in Germany very small button cells the children came in contact with came from toys. The replaced batteries after use were swallowed often.

Chalmers: There is an extensive *battery collection structure* in Germany. in Australia and US there is no such system. *Poison Service* is more often consulted in Germany. Diagnosis in Australia is very difficult, X-ray use poor. Patients go further to the local doctor (GP) before going to hospital. The *time lapse* between ingestion and detection in hospital is longer.

Hahn: There was too much treatment in the 80s of swallowed batteries, similar to coins. Removal was done very often with a magnetic sond. Now we know a battery like a foreign body goes through the gastrointestinal tract. There were no severe cases in the last two decades with perforations and burns. Complications rather in these days when the surgeants wanted to get out the batteries from lower gastrointestinal tract. The *danger of lithium batteries* today is much more higher because of the larger diameter and similarity to a coin. The voltage is higher, too. There will be a short circuit and the tissue will be warmed up much more with the lithium type because the energy is higher. Don‘t think that hydroxide comes out. Hot-dog-test shows: it‘s a question not of hydroxide but of the current. The high voltage lithium batteries could be a problem in future, there also had been a case of explosion of a remote control. The risk of explosion of a lithium battery is much more higher than of other types.

Chalmers: At least 1.3 V is needed for reaction. Even if a spent 3 V battery can cause a reaction. The best solution they are working on is having a covering in the battery. The packaging could also be changed.

Abel: In Germany for example remote controls don‘t have button batteries. Other devices: car keys, greeting cards.

Chalmers: working on closing up the departments, there have been changes for example in greeting cards.

Hahn: Surveillance showed we don‘t have severe intoxications. There was only a *risk communication* to the pediatricians. Every pediatrician here should therefore know the risk of the button batteries. Overall the risk decreased. After unification lamp oil was more a problem for the eastern countries, but not the button cells. The hazard is more comparative to foreign bodies.

Carr: Risk communications in the US are very often not read by physicians. Is the communication in Germany better?

Hahn: We have a text book ’poisoning in Children‘. Every pediatrician in Germany will have this book. Besides there is ’the practical children‘s doctor‘ and other series of literature. So the knowledge is somehow better. German mothers ask a lot about risks, they are perhaps better informed but it depends on the issue (awareness for lamp oil e.g. is not so high). Chalmers: There is a lack of *awareness*. A lot of parents are not aware of the danger.

Abel: There is a high level of environmental policies in Germany. People are aware of recycling and can give the batteries after use back to the traders and to the supermarkets. There is a law that obligates to recycling batteries. UBA informed about environmental issued of products.

Hahn: Mercury button cells in former times (a decade ago). People were very anxious about the Mercury type. Recommendation in our book that the fathers should follow the swallowed battery with a detector. The awareness in Germany could be higher than in other countries.

Abel: The market shows: the rate of button batteries is 15% of all sold batteries. more or less only 2 button batteries per person per year are sold.

Chalmers: The packaging is different, but the mix of batteries sold in Australia, New Zealand, Germany is not different.

> **(Short presentation of the Charité case studies, 29 cases, no severe complications, 2 slight strictures of esophagus that needed further dilatation treatment after lithium cell ingestions)**

Chalmers: Long time until operation in Australia. Often they go to a general practitioner first before realizing what has happened. Carr: is it increased awareness that makes the difference? Almost 3000 cases in the US in a single year. a significant problem is that the ingestion is not observed. Prevention in packaging would be important.

Hahn: *Poison centers* have so many cases that they need the time for consultation. It is difficult to collect standardised data. They are developing a business plan for surveillance similar to the US, costs also plays a role. A Master Student from Leipzig will do further research and put all the data together in a master thesis in around 1 year. Specialists at Vachta-company are also interested in helping in the basic research.

Abel: Percentage of button battery ingestion is really low compared to all the cases of poison control centers. but they have no further information because of the workload and no funds to raise more information about the swallowed products.

Carr: Question on poison control center: are they funded by government entirely?

Hahn: They are not funded by government but by the states. Funding is not enough so they have a lot of services to raise money. Most services are for example creating safety data sheets and information about products. In the future there won‘t be more than 5 poison centres. In the future there could be implemented another funding.

Carr: The same issue in the states, number is shrinking and finance is poor.

Hahn: They are working on better figures, maybe in 3 years, with more follow up so products can be better detected based on the formula.

Chalmers: US/A/NZ there are *awareness campaigns of industry*. They changed the design of the batteries and the packaging. A number of manufacturers and battery retailers are interested in working with us in the campaign. The next 2 or 3 months will be important. Need to build a more extensive awareness program with button batteries included in that.

Carr: Energizer started collaboration with us, but one problem is that the packaging is so small, that danger announcements can‘t be read. Problem has the potential to be amplified, respecting the Lithium batteries. People should be educated about that topic in future.

Hahn: Thinking of developing an *App* (talked to NRH) to raise the awareness of people. People in future would be really interested to get information out of a smartphone more than from textbooks.

Carr: This could be created together rather than being developed individually in all the countries. A consortium of people working on an *App* would make sense.

Chalmers: Community organisations like safe kids and industries create a connection that could be really productive and that is already notable.

Chalmers: A lot of the issues and poisonings are similar between *elderly people and kids.*

Abel: Ministry of health had the same idea, asked to raise a sister organisation for elderly people. there are similar problems but complete different system of players and organisations for elderly people. Needs assessment and structure could not be financialised by the Ministry.

Hahn: There are differences in poisonings because some elderly people get more serious aspirations because of the amount of liquid they swallow, for example this would be interesting to compare.

Carr: ’Safe Kids Canada‘ aka. ’Parachute‘ works on all the range of age. We are also coworking with AARP and share information. At the end of the day we are talking about home safety. Perhaps *Apps* could be created and translated, I would be interested in that.

Chalmers: There are also connections to other countries like Spain and Italy. If we can identify where to find better data, that would be a good objective.