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RESEARCH FUNDED BY WORKSAFEBC

Development of a Working Prototype Sling for Use with Floor and Ceiling Lifts to be used by the Veterinary Sector

April 2005

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RS2002/03-DG03

WORK SAFE BC

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Final Report

WCB Project 2002/03-DG03:

Development of a Working Prototype Sling
For Use with Floor and Ceiling Lifts
to be used by
the Veterinary Sector

Presented to: Worker's Compensation Board of BC
Research Secretariat

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Main Research Findings and Policy/Prevention Implications

- Veterinary workers are at risk of back injury from lifting and moving large dogs
- Existing slings, lifting devices and other aids developed for veterinary use are poorly designed and, in some cases, dangerous to both veterinary staff and animal.
- There is a need for devices to assist in lifting and transferring or carrying large dogs in veterinary clinics
- There is a need for an easy to use stretcher for dogs in veterinary clinics
- To meet this need, the project team has developed a prototype sling that can be used to:
 - lift dogs using a mechanical (manual, hydraulic or electric) lift
 - lift and carry dogs using webbing handles incorporated into the sling design
the dog can also be carried or lifted in the sling without a mechanical lift and
 - carry dogs longer distances by converting into a stretcher.

Executive Summary

The aims and objectives of this project were to develop a working prototype sling, for use in veterinary clinics, that could be manufactured and sold for a reasonable price. Staff in small animal veterinary clinics routinely lift, carry and reposition dogs in the 25kg to 50kg range. Sheep and pigs in this weight range also need to be lifted and moved in large animal practices. Most veterinary clinics do not regularly use lift devices to move animals in this size range, instead lifting these animals manually or with the assistance of towels and blankets. It should therefore be no surprise then that between 1988 and 2002 the combination of musculoskeletal sprains and strains with repetitive strain injury accounted for the majority of WCB claims from the veterinary industry.

Using a formal design process, site visits were done to familiarise the design team with the demands of veterinary work and surveys were completed by veterinary staff at four veterinary clinics which ranged from small general practises to larger specialty hospitals. The purpose of the surveys was to gather information regarding what staff would consider to be the 'perfect' sling for use in lifting dogs in the 25kd to 50 kg weight range. Information taken from the survey was used to generate three significantly different sling designs. Three proof-of-concept prototypes of these designs were made from a range of materials and with a variety of extra features. These prototypes were then presented to focus groups at the three of the four participating veterinary clinics. One design was chosen as the clear favourite by the focus groups and a number of features across the various designs were either given a positive response or a neutral to negative response. The features rated with a high positive response where then

incorporated into the chosen design and a new design was arrived at. This design was produced as an alpha prototype, tested for safety and installed in three of the participating veterinary clinics for a period of one month per clinic. At the end of the one month, trial staff at that clinic were asked for a final round of input on the design. Once feedback from all three trials was collected a beta prototype was produced incorporating the suggested design changes. This beta prototype was then submitted for a design review. The design review confirmed that the beta prototype produced at the end of the project did meet the objectives set out at the start of the project. The final outcome of the project was a sling design that had received very positive reviews from the veterinary clinics at which it had been trialled.

Research Problem/Context

Aims and Objectives

The aims and objectives of this project were to develop a working prototype sling, for use in veterinary clinics, that could be manufactured and sold for a reasonable price.

The sling is to be used in lifting, transferring and repositioning four legged animals in the 25kg to 50kg range. The sling will be compatible with both a reasonably priced lift developed at BCIT for the human health care industry, as well as with other commercially available lift devices.

Problem

Staff in veterinary clinics carry out a significant amount of lifting, transferring and repositioning, of animals in the 25kg to 50kg range. While this primarily involves working with dogs, it can also include pigs, goats and sheep. Most veterinary clinics do not regularly use lift devices to move animals in this size range. Instead, towels and blankets are used to move animals from floor to table or into kennels. Two of the primary reasons for this is are:

- 1) poor design and selection of specialty animal slings available for use with lift devices and
- 2) the cost of lift devices and the (poorly designed) veterinary slings.

The Worker's Compensation Board of BC's claim statistics for 1998 to 2002 indicate that the three main areas of injury to veterinary workers reported in WCB claims are:

- 1) Animal Bites,
- 2) Repetitive Strain Injuries (typically Wrist/Shoulder) and
- 3) Muscle Sprains and Strains (typically Thoracic/Lumbar Spine).

The second two of these three categories are collectively known as musculoskeletal injuries and are typically the result of awkward body postures, especially as related to carrying or shifting loads.

Animals in the 25kg+ category are routinely lifted from the floor to table heights ranging from 33" to 36". In addition to being lifted onto examination and surgical tables, animals must also be lifted from the floor onto gurneys (ranging in height from 28" to 38" and into kennels, which range from 6" off the floor to 36" from the floor in height. In some cases the animals are anaesthetized (a 'dead' weight), in other cases the animals are struggling. An animal struggling to escape provides further challenges to the safety of staff, as well as to its own well being. Unlike human patients, it is not possible to calm an animal by explaining to them that what is being done to them is to their benefit and that it will soon be over. It should be no surprise then that between 1988 and 2002 the combination of musculoskeletal sprains and strains with repetitive strain injury accounted for the majority of WCB claims from the veterinary industry. Despite the fact that veterinarians and veterinary technicians have a high incidence of musculoskeletal injuries and repetitive strain injuries, veterinary clinics rarely have and use the same types of lifts and slings used in the human health care industry, due to the cost of this technology. This is compounded by the lack of good sling designs to use with lifts. Most of the types of injuries reported are consistent with injuries caused in lifting, transferring and repositioning loads in the range of mid to large size dogs. This

indicates that there is a need for a low cost, easy to use, sling design for use by the veterinary sector.

Methodology

Once funding had been granted and prior to the start of the project, ethics approval was sought and gained from the BCIT Ethics Review Board as well as the BC Veterinary Medical Association.

Phase 1) Development of Design Concept

Site Visits and Questionnaires

Phase 1 began with site visits at the four participating veterinary clinics. The purpose of the site visits was to determine what could be expected to be found in a typical veterinary clinic. Methods of lifting currently employed, layout of clinic, activities engaged in, heights of tables (examination, surgical and X-ray), equipment used, and space limitations were all considered. Staff were asked to demonstrate lifting and transferring techniques used in their clinic. At the conclusion of the site visit, Product Specification Questionnaires were left with the clinic for staff to complete.

Questionnaires were picked up by a BCIT researcher, once all participating staff had completed one.

The Product Specification Questionnaire asked vets and technicians to describe what features they would like an ideal sling for lifting and repositioning to have. A copy of the questionnaire can be found in Appendix One.

Seventeen staff, from four clinics completed the questionnaire. Responses were collated and organized and the top concerns and features identified in the questionnaires were used to generate a list of design criteria.

Design Development

These design criteria were developed into a Design Brief, which was used as the foundation of the design process. The Design Brief is shown in Table 1:

Design Brief: WCB Project # 2002/03-DG07: Sling for use in Lifting and Transferring Large Dogs
<ul style="list-style-type: none">• Sling should be easy to use• Sling should be adjustable• Sling should be able to be applied to/ used with sleeping dog, to reposition dog, regardless of dog's position• Sling should be machine washable/cleanable/sterilizable• Sling should not interfere with IV/catheter/leads• Sling should work for dogs > 20kg• Dog must feel secure in sling

Table 1: Design Brief for Veterinary Sling

Details on the results, with number of responses, can be found in Appendix A.

Using these design brief, three sling designs were developed and prototypes were made. The three designs are illustrated in the following pictures.



Pictures 1 a & b: Design #1 – Basic Sling

Design #1, the basic sling was a 'one size fits most' approach. Anthropometric measurements from a series of dogs in the 25kg to 50kg weight range, were used to develop a pattern which would accommodate almost all dogs in this weight range. This design was conceived as not having a front or back, to make it easy to put on in emergency situations. Net fabric was used as some persons had requested a 'transparent' fabric to allow observation of the dog and it's anatomy during a lift or transfer.



Pictures 2 a & b: Design #2 - Adjustable Sling

Design #2, the adjustable sling, was conceived to provide more robust support with a solid heavyweight outdoor fabric. Tabs at each end folded around the chest and the backside of the dog for more support and were adjustable using sliding slide release buckles, such as are found on backpacks. This design had a front and a back end.



Picture 3: Design #3 – Rigid Support Sling

Design #3, the rigid support sling, provided a rigid support, similar to a spinal board that is used in human first aid situations. Two versions of the rigid support were made, one which held the head in an elevated position (Picture4), the other which did not (Pic.5).



Picture 4: Prone Support



Picture 5: Elevated Head Support

This design was highly adjustable as the fabric sections attached to the rigid board with Velcro and could easily be shifted forwards and backwards.

Focus Groups

These three prototypes were then presented to three of the four participating clinics in focus group format, for review. Due to staffing problems one of the smaller clinics decided not to participate in the focus groups, but asked that we contact them at the clinical trial stage at which time they anticipated they would be able to re-join the study. As the clinic was one of the smaller clinics and a similar size clinic was already participating in the project, it was not anticipated that this would have a significant effect on the project.

At the focus groups, each of the slings was shown and demonstrated on a dog. Participating staff evaluated each of the designs using the evaluation forms in Appendix B.

The slings were rated in two ways. First the designs were evaluated individually and against each other. Results from the focus groups showed that

- Design #1 - The Basic Sling was the overwhelming favourite.
- Design #3 – The Rigid Support Sling as rated as second favourite and
- Design #2 – The Adjustable Sling was rated as least favourite.

Second, the design features, such as the webbing handles or ability to turn into a stretcher were rated as to their appeal and perceived usefulness. A number of these features were found in more than one of the designs and any could easily be incorporated into the clinical trial prototype, if people found them to be of interest.

Responses Regarding Design Features:	
<u>Design Feature</u>	<u>Rating</u> 1 = liked very much 10 = don't like at all
Webbing Handles	1.76
Ability to tack handles together	1.71
Nylon Fabric	2.56
Net Fabric	3.72
Rigid Belly Support #A	7.44
Rigid Belly Support #B	7.16
Ability to turn into Stretcher	1.88

Table 2: Focus Group Responses

The features rated as highly desirable were:

1. the webbing handles,
2. the ability to turn the sling into a stretcher and
3. the ability to tack the handles together.

Results from the focus groups were quite similar across the clinics, regardless of size of type of care provided by the clinic (family practice, emergency and specialty hospital).

Based on focus group results, the design for clinical prototype that emerged from the process was the “basic” sling design incorporating the following design features:

1. Webbing Handles
2. A way of ‘tacking’ the handles together while putting sling on and
3. Ability to use as stretcher

The prototype was made from the nylon, as the nylon fabric was ranked over the net.

The resulting sling is shown in Picture 6.



Picture 6: Sling used in Clinical Trial

Phase 3) Evaluation of Working Prototype

Having arrived at a design to be used for testing, clinical trials began. The clinical prototype was produced and tested by suspending it from the lift device for a 24 hour period with a 180Kg weight placed in the sling. At the end of the 24 hours none of the materials had broken, chafed or stretched giving us confidence that the sling was deemed as safe to use in situations where a 25 to 50 kg dog would be suspended in the sling for anticipated periods of no longer than 10 minutes per lift, and typically under 3 minutes per lift.

The BCIT mobile lift was installed at each of the three remaining participating clinics for one month. Training in how to use the lift and sling was given and the clinics were free to use it where they felt it to be appropriate. At the end of the month the lift was removed and installed at the next clinic. The same evaluation form used previously was completed by those staff members which had used the sling at any time during the month.

The fourth clinic that had initially participated in the clinic was contacted and they indicated they might now be interested in participating in the final stage of the study. However, on checking out the size of the lift they decided it was too big to fit into their clinic and informed us that they were formally withdrawing from the study.

Across the three participating clinics, seven staff ended up using the sling with the lift provided. They completed an evaluation of the sling design using the same feedback

forms and criteria that were used with the focus groups. The feedback on the sling design used in the clinical trial is summarized in Table 3.

Responses Evaluating Clinical Trial Prototype	
<u>Criteria</u>	Rating (out of 10) 1 = Liked Very Much 10 = Didn't like at all
Ease of use	3.2
Ability to clean	3.8
Adjustable/Will fit most mid-sized dogs	3.8
Can be applied to sleeping dogs/used with IV/Catheter Leads	8.3
Will work for dogs > 20 kg	2.7
Dogs will feel secure in sling	3.0
<u>Summary of Comments:</u>	
<ul style="list-style-type: none"> • Need for more adjustability with respect to height of head vs. height of tail of dog. (3 responses) • Need for an accommodation for urinary catheters (2 responses) • Dogs felt secure in sling (2 responses) 	

Table 3: Summary of Results of Clinical Trial Evaluation

Phase Four) Incorporation of Evaluation Feedback into Design

Overall feedback on the sling was positive. Two clear directions for further development of the sling design were given. First, the need for an abdominal opening to allow clearance for a catheter and second, the need for more height adjustment. While one comment indicated that the sling did not interfere with IV tubing, several comments came back requesting an abdominal flap for catheter tubing. The need for more height

adjustment came about when it was determined that the dogs became unbalanced as soon as their feet left the ground. This is because more of a dogs weight is in it forequarters as opposed to its hindquarters. With the sling and lift acting similar to a balance scale, the result was a dogs head hanging lower than their tail when being lifted.

Using the feedback from the clinical trial the following design features were incorporated into the sling design.

- 1) An abdominal flap that closes with Velcro™, when not needed
- 2) Adjustment loops for height variation between front and back of dog.

The resulting design is shown in Picture 7 a & b.



Pictures 7 a & b: Post-Clinical Trial Sling Design (Beta Prototype)

Phase Five) Design Review

Following the development of the beta prototype a design review was carried out by a mechanical engineer independent of this project. The results of the design review indicated that the design criteria had been met to a degree satisfactory for a beta prototype. The results of the design review are shown in Table 4.

Criteria	Acceptance Criterion	How well does final prototype meet acceptance criterion? 0=Does not meet 5=Meets very well	Suggested Follow-up Actions
Easy to use	Independent reviewer judgement after demonstrations.	5/5 Very well.	None
Adjustable	Independent reviewer judgement after inspection and demonstration.	4/5 Fairly well. Some question about a very large, but skinny dog.	None
Can be applied to/ used with sleeping dog, to reposition dog,	Independent reviewer judgement after demonstrations.	5/5 Very well.	Next project phase: Answer the question: Can

regardless of dog's position			an unconscious dog breathe when carried in the stretcher?
Machine washable/cleanable/sterilizable	Independent reviewer judgement after inspection and discussion.	4/5 Fairly well.	None
Doesn't interfere with IV/catheter/leads	Independent reviewer judgement after inspection and discussion.	5/5 Very well. May need some fine-tuning, but concept appears sound.	Next project phase: Answer the question: Is the catheter hole in the correct position for female and male dogs within the specified size range.
For dogs > 20kg	Observation of dog subject (75lb) in sling.	5/5 Very well	None
Dog feels secure	Observation of dog subject in sling.	5/5 Very well	None

Table 4: Design Review against Design Criteria for Sling for use in Lifting and Transferring Large Dogs

At the design review meeting there was some discussion around the placement of catheters on female dogs vs. male dogs. Based on input from the reviewer, a final adjustment was made to the design, by elongating the opening in the groin area. The final prototype for this project is pictured in Picture 8.



Picture 8: Post-Clinical Trial Sling Design with Elongated Groin (Beta Prototype)

Research Findings

Implications for Future Research on Occupational Health

This project illustrates that applied research, in the area of product development, had the potential to reduce injuries in the workplace. However, unlike policy or practise based research, developing product based solutions to occupational health issues, requires steps beyond the development the implementation of policy or practise changes. Two more steps are necessary to see that the developed prototypes reach the marketplace, where they will then make their mark on workplace safety. First, the prototype must be refined to the 'market ready' stage. Second, a commercialization plan must be developed and implemented. To this end, the Technology Commercialisation Office (TCO) at BCIT is looking at the sling prototype developed and evaluating it with respect to the feasibility of developing a commercialisation plan for the sling. The work of developing a prototype into a marketable product is often undertaken by the licensee, who will tailor the design development to dovetail with their manufacturing capabilities. Thus, the commercialization strategy will be developed first, before any more work on refinement of the prototype will be done.

Identification of policy and prevention implications arising from research

The resulting sling design will have no effect on policy.

It does have the potential to contribute to prevention of MSI in Veterinary Industry workers, if a pathway to the marketplace can be found for the sling, making it possible for these slings to be purchased by interested veterinary clinics.

Identification of relevant user groups for research results

Users for the sling design developed would be in all small animal practise clinics in BC and in any large animal practises that also see dogs. The BC Veterinary Medical Association has already expressed interest in learning about the results of the project. Other groups interested in the results would be veterinary technician training programs, such as the one at the College of the Caribou (Kamloops) and veterinary assistant programs such as those at West Coast College of Vet Assistants, Granville College and Stenberg College (all in Vancouver).

Dissemination/Knowledge Transfer

Initial efforts in the area of dissemination/knowledge transfer will take place in the area of 'knowledge transfer' through efforts to put a commercialisation plan in place for the sling. The most effective way of ensuring what is learned in this type of study is to ensure that the resulting technology is available to those who would benefit from it. In the case of a product based solution, this starts with a commercialisation plan.

Public dissemination of this study will be delayed until after the commercialisation plan has been done. This report will be disseminated to all clinics participating in this study. The report will also be sent to the BCIT Occupational Health and Safety Program and a follow up will be done with the faculty to determine if they will be able to include discussion about such assistive devices in their curriculum. Finally, a copy of the report will be sent to the BC Veterinary Medical Association and abstracts for presentations on this sling will be presented to local, national and international veterinary conferences, starting with the BC Veterinary Medical Association.

Appendix A

Product Specification Questionnaire Sample And Summary of Results

Date:

Dear Staff Member:

Re: Development of a Working Prototype Sling for Use with Floor and Ceiling Lifts to be used by the Veterinary Sector

Principal Investigator:

Nancy Paris-Seeley, MAsc, PEng, Technology Centre, (604) 432-8754

Co-Investigators:

Silvia Raschke, PhD, C.O. (c)Technology Centre, 604-412-7597

Brian Keane, I.D., Technology Centre, 604-451-7056

Thank you for having agreed to participate in the project entitled "Development of a Working Prototype Sling for Use with Floor and Ceiling Lifts to be used by the Veterinary Sector". This project has recently been funded by the Worker's Compensation Board of British Columbia and the clinic at which you work is one of the clinical sites participating in this project.

The primary purpose of this project is to reduce back injuries in veterinary clinics caused by manually lifting large dogs from the floor onto examination tables or operating tables. This will be done by developing a sling specifically for use with dogs in the 25 to 50 kg range, in conjunction with a lift device already developed by BCIT for the human health care setting.

The anticipated benefits to veterinary staff include receiving training in the safe use of lift and sling devices and a reduction in risk of injury during the time they have the sling available to them.

Your participation in the project will entail:

- Participating in a site visit where BCIT researchers will observe how lifts and transfers are currently done and then completing a 'Product Specification Questionnaire'. This should take approximately one to two hours total.
- Participating in a focus group to review three designs which will be developed from the finalized Product Specification Questionnaire.

- This will take approximately one and a half hours and will take place over a lunch provided by BCIT.
- Training in the use of the prototype sling and then using it when required to lift and transfer dogs between 25kg and 50kg in weight for a period of one month as part of your regular work activities. The training in safe lift and transfer practices, using the prototype sling will take approximately 2 hours. Using the sling as part of your regular duties should not require any additional time.
- Completion of a 'Product Feedback' questionnaire to give feedback on the prototype sling at the end of the month's trial. This should take approximately one hour.

This package contains the first of the two questionnaires you are being asked to complete.

You are free to withdraw from this study at any time. To do so, simply contact Ms. Paris-Seeley at 604-432-8754.

The questionnaires you will be asked to complete are intended to be completely confidential. For this reason, do not put your name on the questionnaires. Design processes are often made more effective by 'bouncing' ideas off of colleagues, so please feel free to speak to other staff members about their ideas before answering the questions. However, do not fill out the questionnaire as a group.

You will be asked to put the completed questionnaire into the envelope provided and seal the envelope. Having done this please give the sealed envelope to your clinic manager. Once all participating staff at your clinic have completed the questionnaires, someone from BCIT will come to collect them.

Instructions regarding how to complete the 'Product Specification Questionnaire' are included with the attached questionnaire. In addition, during the course of the initial site visit, someone from BCIT will be going over the questionnaire, its purpose and its structure with you, in an effort to make it as simple and fast a possible for you to complete. For questions you are unable to answer or do not fall within your area of expertise – simply fill in N/A. If you have any questions about the questionnaire while you are completing them, please feel free to call Silvia Raschke at 604-412-7597 or Brian Keane 604-451-7056.

Sincerely,

Nancy Paris-Seeley, P.Eng.
Principle Investigator

"VETERINARY SLING"
PRODUCT SPECIFICATION QUESTIONNAIRE

27/06/2007

PROJECT: Development of a Working Prototype Sling for Use with Floor and Ceiling Lifts to be used by the Veterinary Sector

Design Problem

Design Objectives

Design Criteria

Functional Criteria

Performance Criteria

User Interface Criteria

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Manufacturing Criteria

Human Factors/Ergonomic Criteria

Aesthetic Criteria

Marketing Criteria

Product Evaluation, Verification and Validation Criteria

Standards & Regulatory Criteria

**Design Criteria for Sling
for use in
Lifting and Transferring Large Dogs**

Criteria	Design Criteria	Performance Criteria	User Interface Criteria	Total
Easy to use	6*	6	17	29
Adjustable	4	3	4	11
Can be applied to/ used with sleeping dog, to reposition dog, regardless of dog's position		3	4	10
Machine washable/cleanable/sterilizable	6		3	9
Doesn't interfere with IV/catheter/leads	2	4	3	9
For dogs > 20kg	3	4		7
Dog feels secure			7	7

*Table lists number of responses per category, from 17 respondents

Appendix B

Focus Group Questionnaire Sample

Focus Group Questionnaire for:

*STUDY ON DEVELOPMENT OF A VETERINARY SLING FOR LARGE
DOGS FOR USE WITH LIFTING DEVICES BY VETERINARY WORKERS*

BCIT Technology Centre
Health Technology Research Group
Principle Investigator: Ms. Nancy Paris-Seeley
Funder: Worker's Compensation Board of British Columbia

Instructions:

Following the demonstration of the three designs presented, please complete the following questionnaire and put it in the manila envelope provided upon completion.

The entire task should take one hour.

All responses will be transcribed and collated by an independent party to maintain respondent's anonymity.



Design #2 (purple fabric)

Ease of Use

1 2 3 4 5 6 7 8 9 10
easy difficult

Ability to Clean

1 2 3 4 5 6 7 8 9 10
easy difficult

Adjustable/Will fit most mid size dogs

1 2 3 4 5 6 7 8 9 10
easy difficult

Can be applied to sleeping dogs/used for repositioning

1 2 3 4 5 6 7 8 9 10
easy difficult

Doesn't interfere with IV/Catheter Leads

1 2 3 4 5 6 7 8 9 10
won't interfere will interfere

Will work for dogs greater than 20kg

1 2 3 4 5 6 7 8 9 10
will work won't work

Dogs will feel secure in sling

1 2 3 4 5 6 7 8 9 10
dog will feel secure dog will not feel secure

Overall Impressions

Webbing Handles

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Ability to tack handles together

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Nylon Fabric

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Net Fabric

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Rigid Belly Support #A

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Rigid Belly Support #B

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Ability to Turn into Stretcher

1 2 3 4 5 6 7 8 9 10
liked very much no opinion didn't like at all

Comments:

Rate the designs from favourite to least favourite:

Liked Best: _____

Why?

Liked Second Best: _____

Why?

Liked Least: _____

Why?

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