

## The Outcomes Toolbox

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## Evidence-Based Practice (EBP)

[www.wikipedia.org](http://www.wikipedia.org)

- Formally introduced in 1992 with Evidence-based Medicine (EBM)
- “All practical decisions made should:
  - Be based on research studies, &
  - That these research studies are selected & interpreted according to some specific norms characteristic for EBP.”
- Disregard theoretical & qualitative studies
- Considering quantitative studies according to a narrow set of criteria
  - What is “evidence”?

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## Evidence-Based Behavioral Practice (EBBP)

[www.wikipedia.org](http://www.wikipedia.org)

- “Making decisions about how to promote health or provide care by integrating the best AVAILABLE evidence with practitioner expertise & other resources...”
- “In a manner that is compatible with the environmental & organizational context...”

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**Are my clinical decisions...**

- Effective?
- Ethical?
- Efficient?

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**EBP in Animal Rehabilitation**

- Evidence-Based Veterinary Medicine Association (EBVMA) in 2004 (Mississippi State U)
  - [www.ebvma.org](http://www.ebvma.org)
- Centre for Evidence-Based Veterinary Medicine in 2009 (Novartis & U of Nottingham, UK)
  - <http://www.nottingham.ac.uk/CEVM/index.aspx>
- ACVS Outcomes Measures Program (OMP) in 2006
  - <http://www.acvs.org/acvsfoundation/outcomesmeasures/index.cfm>
- APTA Clinical Research Agenda for Physical Therapy in 2000
  - [www.hookedonevidence.org](http://www.hookedonevidence.org)
  - [www.apta.org/opendoor/](http://www.apta.org/opendoor/)
  - [www.apta.org/Ptnow/](http://www.apta.org/Ptnow/)
- Evidence in Motion in 2004
  - [www.evidenceinmotion.com](http://www.evidenceinmotion.com)
- Physiotherapy Evidence Database (PEDro) in 1999 (The Centre for Evidence-based Physiotherapy, The George Institute for Global Health, University of Sydney, Australia)
  - [www.pedro.org.au/](http://www.pedro.org.au/)

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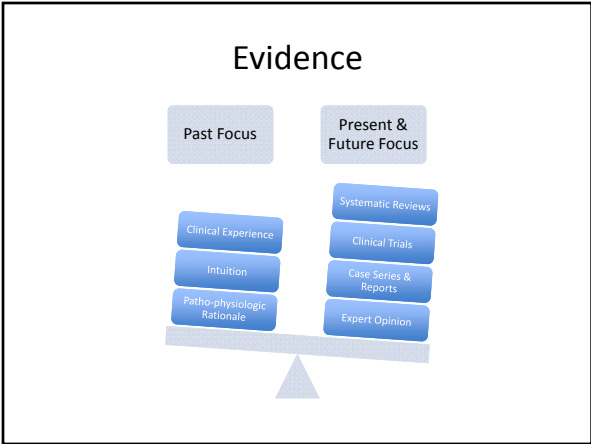
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### Our Unusual Problem?

- Animal rehabilitation is a relatively new discipline
  - 1978 Ann Downer (OSU)
- Life expectancy of companion animals is increasing ([www.vetinfo.com](http://www.vetinfo.com))
  - 12.8 years for “random breed dog”
- Animal “sports” are becoming more popular ([www.thebark.com](http://www.thebark.com))
  - Entries in AKC sports in 2010 >3 million
  - Entries in agility increased by 9%
- 62% of US households own a pet ([www.americanpetproducts.org](http://www.americanpetproducts.org))
- Pet industry expenditures were estimated to be \$52.87 BILLION in 2012
  - Food \$20.46 billion
  - Veterinary Care \$13.59 billion
  - Supplies/OTC Medications \$12.56 billion
- Are we being blamed or congratulated for our patients’ successes?
  - Are positive outcomes due to time, money, or effective care?

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### Why Should I Care about EBBP?

- Appropriate communication
- Efficient & effective patient care
- Client & referral source satisfaction
- Financial solvency
  - Third party payers
    - 1% of US pets insured in 2012 vs. 20% in Europe ([www.usatoday.com](http://www.usatoday.com))
    - Pet insurance revenue ↑ from \$303 million (2009) to a projected \$753 million in 2014
- Ensure vitality & acceptance of PHYSICAL THERAPY theories, techniques, interventions, & modalities as a standard of practice in veterinary medicine

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### Outcome Measures

- Tools, tests, or scales “that have been shown to measure accurately a particular attribute of interest... & are expected to be influenced by the intervention”
- Objective
- Quantitative
- Valid (measures what it intends to measure)
- Standardized procedure
  - Administration
  - Scoring
- Reliable (producing consistent & reproducible results)
- Responsive to clinical change
- Address an operationally defined, clinically relevant, & MEANINGFUL question

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### Operational Definition

- Precise
- Specific
- Measurable
- Consensus in physical therapy & veterinary medicine
  - “Manipulation”?
  - “Flexion” or “extension”?
  - “Lameness” or “gait deviation” or “antalgic gait”?

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### Subjective Measures

- Historical information
- Client goals & expected outcomes
- Client description of pain behaviors
  - Acute Pain Scale
  - Helsinki Chronic Pain Index
  - Glasgow Composite Pain Scale—Canine Short Form
    - Feline Pain Scale (derived from GCPS)
  - Pain Assessment Questionnaire for Dogs with Osteoarthritis

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### AAHA: Pain is the 4<sup>th</sup> Vital Sign (2007)

- Temperature, pulse/heart rate, respiratory rate (TPR), & pain
- All can be assessed before, during, & after implementation of a rehab intervention; long & short term; at rest vs. during activity; with palpation or with PROM
  - Patient tolerance
  - Safety of intervention (Red flags?)
  - Improvement in fitness levels?
- Pain management might be the primary reason for referral (or self-referral) to PT
  - Outcome measures will lead to modification of the PT plan of care if this objective is not met (or progress is not made)

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### Signs of Pain

Aloff B. Canine Body Language: A Photographic Guide Interpreting the Native Language of the Domestic Dog

- Patient-specific (socially-acquired) behaviors
  - Effect of medications
  - Presence (or absence) of owner/client
- Situation-related behaviors
  - “White-coat syndrome”
  - Environmental stimuli (sounds, smells, etc.)
- Breed-specific behaviors
- Changes in behavior or demeanor
  - Anxiety, excitement, fear
- Variability in HR, RR
- $\Delta$  in activity level
  - Locomotion
- $\Delta$  in appetite
- Tail carriage
- Facial expression
  - Ear position
- Vocalization

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### Objective Measurement of Pain

- Pressure algometers & dolorimeters
  - Pain threshold/intensity
  - Pain tolerance
  - Pain sensitivity
- Buhari S et al. Subcutaneous administration of Tramadol after elective surgery is as effective as intravenous administration in relieving acute pain & inflammation in dogs. The Scientific World Journal, vol. 2012, Article ID 564939, 7 pages, 2012. doi:10.1100/2012/564939

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### Acute Pain Scale

[http://www.ivagn.org/attachments/097\\_CSUS%20Acute%20Pain%20Scale%20-%20Canine%20v.2.pdf](http://www.ivagn.org/attachments/097_CSUS%20Acute%20Pain%20Scale%20-%20Canine%20v.2.pdf)

Colorado State University  
Veterinary Medical Center  
Canine Acute Pain Scale

Date: \_\_\_\_\_  
Time: \_\_\_\_\_

Pain Scale	Examples	Psychological & Behavioral	Respiratory & Pulmonary	Body Tension
0		<input type="checkbox"/> Comfortable when resting <input type="checkbox"/> Feeds normally <input type="checkbox"/> Responds to person about forthcoming handling	<input type="checkbox"/> Responds to position of animal or caregiver etc. in an appropriate manner	Minimal
1		<input type="checkbox"/> Comfortable when handled or walked <input type="checkbox"/> Responds readily to handling	<input type="checkbox"/> Responds to palpation of animal's chest, or other body part by looking around, backing, or withdrawing	Mild
2		<input type="checkbox"/> Alert, uncomfortable when walking <input type="checkbox"/> Does not relax or lie on its side or back <input type="checkbox"/> Responds to person about forthcoming handling <input type="checkbox"/> Responds to person about forthcoming handling <input type="checkbox"/> Responds to person about forthcoming handling	<input type="checkbox"/> Responds to palpation of animal's chest, or other body part by looking around, backing, or withdrawing	Mild to Moderate Respiratory effort
3		<input type="checkbox"/> Uncomfortable when walking, sitting or standing <input type="checkbox"/> Responds to person about forthcoming handling <input type="checkbox"/> Responds to person about forthcoming handling <input type="checkbox"/> Responds to person about forthcoming handling	<input type="checkbox"/> Responds to palpation of animal's chest, or other body part by looking around, backing, or withdrawing	Moderate Respiratory effort
4		<input type="checkbox"/> Uncomfortable when walking, sitting or standing <input type="checkbox"/> Responds to person about forthcoming handling <input type="checkbox"/> Responds to person about forthcoming handling <input type="checkbox"/> Responds to person about forthcoming handling	<input type="checkbox"/> Responds to palpation of animal's chest, or other body part by looking around, backing, or withdrawing	Severe Respiratory effort

Unable to palpate  
 None  
 None

Comments: \_\_\_\_\_

© 2009/10/10/11/12/13/14/15/16/17/18/19/20/21/22/23/24/25/26/27/28/29/30/31/32/33/34/35/36/37/38/39/40/41/42/43/44/45/46/47/48/49/50/51/52/53/54/55/56/57/58/59/60/61/62/63/64/65/66/67/68/69/70/71/72/73/74/75/76/77/78/79/80/81/82/83/84/85/86/87/88/89/90/91/92/93/94/95/96/97/98/99/100/101/102/103/104/105/106/107/108/109/110/111/112/113/114/115/116/117/118/119/120/121/122/123/124/125/126/127/128/129/130/131/132/133/134/135/136/137/138/139/140/141/142/143/144/145/146/147/148/149/150/151/152/153/154/155/156/157/158/159/160/161/162/163/164/165/166/167/168/169/170/171/172/173/174/175/176/177/178/179/180/181/182/183/184/185/186/187/188/189/190/191/192/193/194/195/196/197/198/199/200/201/202/203/204/205/206/207/208/209/210/211/212/213/214/215/216/217/218/219/220/221/222/223/224/225/226/227/228/229/230/231/232/233/234/235/236/237/238/239/240/241/242/243/244/245/246/247/248/249/250/251/252/253/254/255/256/257/258/259/260/261/262/263/264/265/266/267/268/269/270/271/272/273/274/275/276/277/278/279/280/281/282/283/284/285/286/287/288/289/290/291/292/293/294/295/296/297/298/299/300/301/302/303/304/305/306/307/308/309/310/311/312/313/314/315/316/317/318/319/320/321/322/323/324/325/326/327/328/329/330/331/332/333/334/335/336/337/338/339/340/341/342/343/344/345/346/347/348/349/350/351/352/353/354/355/356/357/358/359/360/361/362/363/364/365/366/367/368/369/370/371/372/373/374/375/376/377/378/379/380/381/382/383/384/385/386/387/388/389/390/391/392/393/394/395/396/397/398/399/400/401/402/403/404/405/406/407/408/409/410/411/412/413/414/415/416/417/418/419/420/421/422/423/424/425/426/427/428/429/430/431/432/433/434/435/436/437/438/439/440/441/442/443/444/445/446/447/448/449/450/451/452/453/454/455/456/457/458/459/460/461/462/463/464/465/466/467/468/469/470/471/472/473/474/475/476/477/478/479/480/481/482/483/484/485/486/487/488/489/490/491/492/493/494/495/496/497/498/499/500/501/502/503/504/505/506/507/508/509/510/511/512/513/514/515/516/517/518/519/520/521/522/523/524/525/526/527/528/529/530/531/532/533/534/535/536/537/538/539/540/541/542/543/544/545/546/547/548/549/550/551/552/553/554/555/556/557/558/559/560/561/562/563/564/565/566/567/568/569/570/571/572/573/574/575/576/577/578/579/580/581/582/583/584/585/586/587/588/589/590/591/592/593/594/595/596/597/598/599/600/601/602/603/604/605/606/607/608/609/610/611/612/613/614/615/616/617/618/619/620/621/622/623/624/625/626/627/628/629/630/631/632/633/634/635/636/637/638/639/640/641/642/643/644/645/646/647/648/649/650/651/652/653/654/655/656/657/658/659/660/661/662/663/664/665/666/667/668/669/670/671/672/673/674/675/676/677/678/679/680/681/682/683/684/685/686/687/688/689/690/691/692/693/694/695/696/697/698/699/700/701/702/703/704/705/706/707/708/709/710/711/712/713/714/715/716/717/718/719/720/721/722/723/724/725/726/727/728/729/730/731/732/733/734/735/736/737/738/739/740/741/742/743/744/745/746/747/748/749/750/751/752/753/754/755/756/757/758/759/760/761/762/763/764/765/766/767/768/769/770/771/772/773/774/775/776/777/778/779/780/781/782/783/784/785/786/787/788/789/790/791/792/793/794/795/796/797/798/799/800/801/802/803/804/805/806/807/808/809/810/811/812/813/814/815/816/817/818/819/820/821/822/823/824/825/826/827/828/829/830/831/832/833/834/835/836/837/838/839/840/841/842/843/844/845/846/847/848/849/850/851/852/853/854/855/856/857/858/859/860/861/862/863/864/865/866/867/868/869/870/871/872/873/874/875/876/877/878/879/880/881/882/883/884/885/886/887/888/889/890/891/892/893/894/895/896/897/898/899/900/901/902/903/904/905/906/907/908/909/910/911/912/913/914/915/916/917/918/919/920/921/922/923/924/925/926/927/928/929/930/931/932/933/934/935/936/937/938/939/940/941/942/943/944/945/946/947/948/949/950/951/952/953/954/955/956/957/958/959/960/961/962/963/964/965/966/967/968/969/970/971/972/973/974/975/976/977/978/979/980/981/982/983/984/985/986/987/988/989/990/991/992/993/994/995/996/997/998/999/1000

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## Helsinki Chronic Pain Index

Helsinki University  
Department of Veterinary Medicine  
2011

**OWNER QUESTIONNAIRE - HCPI-2**

Date: \_\_\_\_\_ Questionnaire no: 1 2 3 4 5 6 7 8 9 10 \_\_\_\_\_

Name of Dog: \_\_\_\_\_ Breed: \_\_\_\_\_

Owner: \_\_\_\_\_ Owner's telephone: \_\_\_\_\_

Tick only one answer - the one that best describes your dog during the preceding week

1. The dog's mood is:  
Very alert  alert  neither alert, nor indifferent  indifferent  very indifferent

2. The dog often:  
Vocalizes  whinges  whines  yelps  barks  howls  howls  howls  howls

3. How long when your dog reaches pain (swelling, lameness, whining, crying out etc.):  
Never  hardly ever  occasionally  often  very often

4. The dog walks:  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  with great difficulty

5. The dog often limping (dragging limbs or the neck like "crabbing"):  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  does not limp at all

6. The dog pulls (high level of resistance):  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  does not pull at all

7. The dog jumps up, lies on, runs with...:  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  does not jump at all

8. The dog lies down:  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  with great difficulty

9. The dog often from a lying position:  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  with great difficulty

10. The dog often after a long rest:  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  with great difficulty

11. The dog often after major activity or heavy exercise:  
With great ease  with ease  neither with ease, nor with difficulty  with difficulty  with great difficulty

Thank You for your help!

Veterinarian's notes:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

This Helsinki Chronic Pain Index has been developed at the University of Helsinki, Finland.  
For more information, please contact: Riitta Siltanen, DVM, PhD  
r.siltanen@helsinki.fi

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## Glasgow Composite Pain Scale – Canine Short Form

- Is the dog...  
– Quiet (0), crying/whimpering, groaning, screaming (3)?
- Is the dog...  
– Ignoring any wound/painful area (0), looking at it, licking it, robbing it, chewing it (4)?
- When the dog rises or walks, is it...  
– Normal (0), lame, slow/relevant, stiff, refuses to move (4)?
- With gentle pressure 2" around a wound/painful area, the dog...  
– Does nothing (0), looks around, flinches, growls/guards the area, snaps, cries (5)
- Is the dog...  
– Happy/content/bouncy (0), quiet, indifferent/nonresponsive to surroundings, nervous/anxious/fearful, depressed/nonresponsive to stimulation (4)?
- Is the dog...  
– Comfortable (0), unsettled, restless, hunched/tense, rigid (4)?

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## GCPS-SF

- Maximum score = 24
- If assistance is required for locomotion, do not complete the mobility assessment (maximum score = 20)
- Analgesic intervention recommended for score  $\geq 6/24$  or  $5/20$

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### Feline Pain Scale

- Is the cat...
  - Comfortable/relaxed(0), lateral with limbs extended/muscles tense, sternal with arched back/head low/reluctant to move, frequently moving/unable to find a comfortable position (3)?
- Is the cat...
  - Looking with bright/alert eyes/ears (0), looking with slightly dull eyes/flat ears, looking with partially closed eyes/ears flat & to the side, growling/hissing with an aggressive facial expression, depressed with semi-closed eyes, elevated 3<sup>rd</sup> eyelid/ears flat to the side (4)?
- When interacting with the cat, is it...
  - Interested in you/surroundings, friendly (0), quiet/uninterested/indifferent, attempting to hide/escape/scared, agitated/aggressive/attempting to scratch/bite, refuses to move or is unresponsive (4)?
- With gentle pressure 2" around a wound/painful area, the cat...
  - Does nothing (0), flinches/vocalizes, turns head towards you/vocalizes/tries to bite, escapes/tries to bite when approached/doesn't allow palpation, is too rigid so to avoid painful movement (5)
- Is the cat...
  - Happy/content (0), quiet, indifferent/nonresponsive to surroundings, nervous/anxious/fearful, depressed/nonresponsive to stimulation (4)?
- Is the cat...
  - Comfortable (0), unsettled, restless, hunched/tense, rigid (4)?

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### Pain Assessment Questionnaire for Dogs with Osteoarthritis

Hielm-Bjorkman et al. JAVMA 2003;222(11):1552-1558.

- In general, how is your dog's appetite?
  - Very good (0), good, neither good nor poor, poor, very poor (4)
- In general, what is your dog's mood?
  - Very alert, alert, neither alert nor indifferent, indifferent, very indifferent
- What is your dog's frequency of contact with human family members?
- What is your dog's frequency of tail wagging?
- What is your dog's frequency of pacing?
  - Very often, often, sometimes, hardly ever, never
- What is your dog's level of activity?
  - Overactive, active, neither active nor calm, calm, too calm/apathetic
- What is your dog's willingness to participate in playing or in games?
  - Very willing, willing, reluctant, very reluctant, does not participate at all

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| <ul style="list-style-type: none"> <li>• Is your dog willing to walk?</li> <li>• Is your dog willing to trot?</li> <li>• Is your dog willing to gallop?</li> <li>• Is your dog willing to jump?</li> <li>• Is your dog willing to walk up stairs?</li> <li>• Is your dog willing to walk down stairs?                             <ul style="list-style-type: none"> <li>– Very willing, willing, reluctant, very reluctant, does not participate at all</li> </ul> </li> <li>• How does your dog lie down?</li> <li>• How does your dog get up after rest?                             <ul style="list-style-type: none"> <li>– With great ease, easily, neither easily nor with difficulty, with difficulty, with great difficulty</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Have you observed your dog panting excessively?</li> <li>• Have you observed your dog licking his lips?</li> <li>• Have you heard your dog audibly complain or vocalize?</li> <li>• Is your dog aggressive towards humans?</li> <li>• Is your dog aggressive towards other dogs?</li> <li>• Is your dog submissive in a "pack"?</li> <li>• Does your dog have problems moving after a long rest?</li> <li>• Does your dog have problems moving after heavy exercise?                             <ul style="list-style-type: none"> <li>– Never, hardly ever, sometimes, often, very often</li> </ul> </li> </ul> |
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### Canine Brief Pain Inventory (CPBI)

<http://research.vet.upenn.edu/PennChart/AvailableTools/tabid/1969/Default.aspx>

- Client/owner assessment (0-10 NRS) of chronic pain
  - Valid, reliable, responsive for hip dysplasia, appendicular bone cancer
- Severity Score (average)
  - What is your pet's pain...
    - At the worst?
    - At the least?
    - On average?
    - Right now?
- Interference Score (average)
  - How does pain interfere with normal functioning? (6 questions)
- Quality of life question

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### CBPI

Patient/Study ID# \_\_\_\_\_

**Canine Brief Pain Inventory (CBPI)**

*Description of Pain:*

Rate your dog's pain:

- Fill in the oval next to the **num. number** that best describes the pain at its **worst** in the last 7 days.
 

0  1  2  3  4  5  6  7  8  9  10  
 Extreme Pain  
 No Pain
- Fill in the oval next to the **num. number** that best describes the pain at its **best** in the last 7 days.
 

0  1  2  3  4  5  6  7  8  9  10  
 Extreme Pain  
 No Pain
- Fill in the oval next to the **num. number** that best describes the pain at its **average** in the last 7 days.
 

0  1  2  3  4  5  6  7  8  9  10  
 Extreme Pain  
 No Pain
- Fill in the oval next to the **num. number** that best describes the pain as it is **right now**.
 

0  1  2  3  4  5  6  7  8  9  10  
 Extreme Pain  
 No Pain

*Description of Function:*

Fill in the oval next to the **num. number** that describes how during the past 7 days **pain has interfered** with your dog's:

- General Activity**

0  1  2  3  4  5  6  7  8  9  10  
 Does not Interfere  
 Completely Interfere
- Playment of Life**

0  1  2  3  4  5  6  7  8  9  10  
 Does not Interfere  
 Completely Interfere

*Description of Function (continued):*

Fill in the oval next to the **num. number** that describes how during the past 7 days **pain has interfered** with your dog's:

- Ability to Rise to Standing From Lying Down**

0  1  2  3  4  5  6  7  8  9  10  
 Does not Interfere  
 Completely Interfere
- Ability to Walk**

0  1  2  3  4  5  6  7  8  9  10  
 Does not Interfere  
 Completely Interfere
- Ability to Run**

0  1  2  3  4  5  6  7  8  9  10  
 Does not Interfere  
 Completely Interfere
- Ability to Climb Up (for example Stairs or Curbs)**

0  1  2  3  4  5  6  7  8  9  10  
 Does not Interfere  
 Completely Interfere

**Overall Impression:**

Fill in the oval next to the **num. response** that describes your dog's overall quality of life over the last 7 days.

Poor  Fair  Good  Very Good  Excellent

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### Objective Measures

- Weight & Body Condition Score (BCS)
- Girth
  - Strength
  - Inflammation/Edema
- Range of Motion
- Functional Mobility

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## Body Condition & Composition

- Weight management important especially in patients with osteoarthritis &/or IVDD ([www.pettedbliss.com](http://www.pettedbliss.com))
- Objective measures
  - Body weight
  - Weight-height ratio
  - Body condition scores (BCS)
  - Dual energy x-ray absorptiometry (DEXA)
  - Girth measures (neck, chest, waist, thigh)

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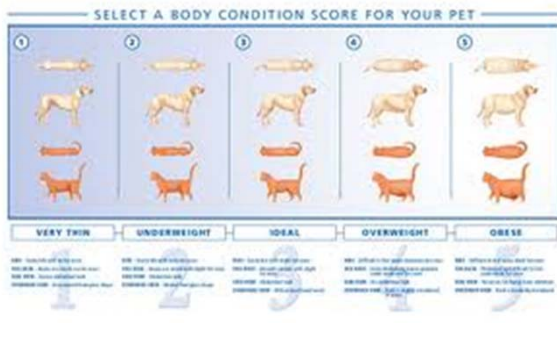
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## Hill's BCS

[www.vetcetera.com/about\\_bcs.asp](http://www.vetcetera.com/about_bcs.asp)




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## Purina BCS

[www.purinaveterinarydiets.com/resources/files/dog\\_chart.pdf](http://www.purinaveterinarydiets.com/resources/files/dog_chart.pdf)




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Purina BCS

[www.purinaveterinarydiets.com/resources/files/cat\\_chart.pdf](http://www.purinaveterinarydiets.com/resources/files/cat_chart.pdf)

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Hill's BFI

[www.hillsvet.com/conference-documents/Weight\\_Management/Therapeutic\\_Weight\\_Reduction\\_Program/Hills\\_Therapeutic\\_Weight\\_Reduction\\_Program\\_Laminated.pdf](http://www.hillsvet.com/conference-documents/Weight_Management/Therapeutic_Weight_Reduction_Program/Hills_Therapeutic_Weight_Reduction_Program_Laminated.pdf)

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### Muscle Strength

- Muscle torque production
- Inadequate strength? Muscle imbalances? Compensatory movement strategies?
  - Risk factors for future injury or exacerbation?
- Direct: MRI, CT, DEXA
- Indirect: Serial girth measurement
  - No significant difference if fur clipped or intact, patient sedated or awake
  - Cooper H et al. Use & misuse of the tape measure as a means of assessing muscle strength & power. Rheumatol Rehabil. 1981 Nov;20(4):211-8.
- Impractical: MMT, dynamometry
- Qualitative: Descriptions of functional strength, muscular endurance, & motor control
- EMG & kinematics

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## Inflammation/Edema

- Serial circumferential girth measurements
- Water displacement volumetry

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## PROM

- Dogs:
  - Jaeger G, Marcellin-Little DJ, Levine D. Reliability of goniometry in Labrador Retrievers. AJVR 2002 Jul;63(7):979-86.
  - <http://www.utc.edu/Faculty/David-Levine/Goniometry.pdf>
- Cats:
  - Jaeger et al. Validity of goniometric joint measurements in cats. AJVR 2007 Aug;68(8):822-6.
  - <http://avmajournals.avma.org/doi/abs/10.2460/ajvr.68.8.822?journalCode=ajvr>
- Affected by:
  - Overpressure
    - What is the endfeel?
  - Pain
  - Patient & joint position
  - Patient medicated or sedated
  - Is there spasticity, crepitus/popping/grinding, or pain?
    - What is the patient's response to PROM?
- Attention to passive insufficiency? Flexibility?

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## Functional Mobility

- Including:
  - Static vs. dynamic postures
  - Transitions or transfers
  - Gait
  - ADL
- Considering ROM, functional strength, motor control, static & dynamic balance, & proprioception
- Levels of independence
- Balance grades
- Functional scores & scales
  - Cincinnati Orthopaedic Disability Index
  - Canine Functional Independence Measure (CFIM)
  - Quality of Life (5H2M) Scale
  - Canine Timed Up & Go Test (CTUG)
  - *Functional Stifle Score*
  - *Bioarth Functional Evaluation Scale*
  - *Hip Score*

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### Operational Definitions of Traditional PT Levels of Functional Independence

- Independent (I)
  - Complete independence with task, timely, safely.
- Modified independence (modI)
  - Independent with a device or with more time required.
- Supervision (S)
  - Subject performs 100% of task with therapist/handler present for safety.
- Contact guard assistance (CGA)
  - Subject performs 100% of task with therapist/handler in manual contact with subject for safety.
- Minimal assistance (minA)
  - Subject performs at least 75% of task.
- Moderate assistance (modA)
  - Subject performs 50-75% of task.
- Maximal assistance (maxA)
  - Subject performs 25-50% of task.
- Dependence (D)
  - Total assist of therapist/handler necessary, subject performs less than 25% of task.

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### Operational Definitions of Traditional PT Static & Dynamic Balance Grades (Sitting & Standing Positions)

- Normal
  - Able to maintain balance without support.
  - Accepts maximum challenge.
  - Can weight shift in all directions.
- Good
  - Able to maintain balance without support.
  - Accepts moderate challenge.
  - Can weight shift but with limitations.
- Fair
  - Able to maintain balance without support.
  - Cannot tolerate challenge or maintain balance with weight shift.
- Poor
  - Requires support to maintain balance.
- Zero
  - Requires maximum assistance to maintain balance.

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### Gait

- Static & dynamic
- Standing
- Walking
- Trotting
- Descriptors of weight bearing
  - NWB
  - TTWB
  - PWB
  - WBAT
  - FWB

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### Static Weight Bearing & Distribution

- Four calibrated bathroom scales
- Stance Analyzer by PetSafe
- Uni-Cam Quadruped Biofeedback System
- Sphygmomanometer cuff pressure measurement

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### Dynamic Kinematic Gait Analysis

- Vicon
- GAITRite
- Tekscan
- AMTI

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### Description of Gait Deviations

- Evans C et al. Method of analysis of canine slow walk. Orthopaedic Practice, 2003;15(2):10-17.
- AROM
- Weight bearing
  - Frequency
  - Quality
- Cadence
- Stance or swing time

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**Quality of Life (5H2M) Scale**  
Villalobos A. Quality of life assessment techniques for veterinarians. Vet Clin Small Anim,41(2011):519-29.

- DVM committed to prevention/relief of animal suffering
  - Aging, ailing, terminally ill pets
  - Palliative care, pet hospice
- Caregivers’ responses on scale can make them more aware of areas of home or veterinary care than need more attention
  - For example, if there are pressure sores, the pet’s bedding might be re-evaluated or a turning schedule might be implemented.

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**Quality of Life**  
McMillan FD. Quality of life in animals. JAVMA,216 (12): June 15, 2000. 1904-10.

- Quality of life does not have an operational definition but is judged individually based on client values & preferences
- “QoL is a multidimensional, experiential continuum. It comprises an array of affective states, broadly classifiable as comfort-discomfort & pleasure states. In general, the greater the pleasant & lesser the unpleasant affects, the higher the QoL. QoL is a uniquely individual experience & should be measured from the perspective of the individual.”

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**Five Freedoms of Animal Welfare**  
[www.fawc.org.uk/freedoms.htm](http://www.fawc.org.uk/freedoms.htm)

- Freedom from hunger & thirst
- Freedom from discomfort
- Freedom from pain, injury, or disease
- Freedom to express normal behaviour
- Freedom from fear & distress

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### 5H2M Quality of Life Scale

- Hurt, hunger, hydration, hygiene, happiness, mobility, “more good days than bad days” (5H2M)
  - Each rated 0-10
- Score of >35 points is an acceptable QoL
- Proxy evaluation (by client/owner/caregiver)
- Unsubstantiated validity of all QoL scales

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### 5H...

- Hurt: adequate pain control, including breathing ability, is first & foremost on the scale. Is the pet’s pain successfully managed? Is oxygen necessary?
- Hunger: Is the pet eating enough? Does hand feeding help? Does the patient require a feeding tube?
- Hydration: Is the patient dehydrated?? For patients not drinking enough water, use subcutaneous fluids once or twice daily to supplement fluid intake.
- Hygiene: The patient should be kept brushed & cleaned, particularly after elimination. Avoid pressure sores & keep all wounds clean.
- Happiness: Does the pet express joy & interest? Is it responsive to things around it (e.g. family, toys)? Is the pet depressed, lonely, anxious, bored, or afraid? Can the pet’s bed be near the kitchen & moved near family activities so as not to be isolated?

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### ...2M

- Mobility: Can the patient get up without assistance? Does the pet need human or mechanical help, such as a cart? Does it want to go for a walk? Is it having seizures or stumbling? Some caregivers believe euthanasia is preferable to amputation, but an animal with limited mobility may still be alert & responsive & can have a good QoL as long as the family is committed to quality care.
- More Good Days Than Bad: When bad days outnumber good days, QoL might be too compromised. When a healthy human-animal bond is no longer possible, the caregiver must be made aware that the end is near. The decision needs to be made if the pet is suffering. If death comes peacefully & painlessly, that is ok.

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### Roxy: A Case Study

- Roxy is a 7 y.o. SF Dogue de Bordeaux
  - Bilateral TPLO 2009, 2010
  - Cervical FCE 2011
  - Cervical decompression/ventral slot 2012
- Outcomes:
  - ROM
  - Girth for strength
  - C-FIM
  - Acute pain scale
  - OA scale

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### The End (or just the beginning)

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# Measuring Change in Canine Rehabilitation: Outcome Tools for Clinicians

Cindy McGregor, PT, PhD, OCS

## Objectives

- 1. Identify owner-completed subjective tools for lameness which have strong psychometric properties.
- 2. Recognize subjective tools with poor testing properties.
- 3. Discuss the advantages and disadvantages of various objective tools for measurement of lameness, quality of life, functional mobility, or associated pain.
- 4. Determine the appropriateness of portable pressure, balance, and kinematic systems.
- 5. Discuss the Canine Timed Up and Go test in terms of indications, limitations, and metric properties.
- 6. Administer the CTUG and use the results to focus treatment on specific impairments.

## Next 2 hours...

### • Subjective Tools

- Test properties
- Formats
- In-house scales
- Canine Movement Assessment Questionnaire
- Canine Brief Pain Inventory

### • Objective Tools

- Force plates \$250,000
- Walk/trot portable pressure mats 30,000
- Stationary balance systems 4,000
- Canine Timed Up and Go song

## Psychometric Properties



- **Reliability**
  - Intrarater – 1 rater on multiple occasions
  - Interrater – between 2 or more raters
  - Test-retest – stability; repeated administrations when thing being measured hasn't changed
- **Validity**
  - Face - weakest, appears to test what it claims
  - Content – items in tool adequately sample the universe of the target variable
  - Criterion
    - Concurrent with gold standard
    - Predictive – criterion will be available in future
  - Construct
    - Extreme groups – are 2 groups distinguishable on new test
    - Convergent – compare 2 tools measuring same construct
    - Discriminant (AKA divergent) – not correlated with unrelated variables

## Psychometric Properties



- **Sensitivity/Responsiveness**
  - Sensitivity – ability to measure any amt of change
  - Responsiveness – ability to measure clinically important change
  - **MDC** – Minimal detectable change
    - Amount of change needed to exceed measurement error (a formula)
  - **MCID** – Minimal clinically important difference
    - Amt of change in external criterion (such as GRCS) to merit change in intervention
  - **MCII** – Major clinically important improvement
    - More definitive response
    - Value dependent on method used (ie. 3 anchor-based approaches to 20cm step test: 5, 12.8, 16.4)

## Simple Subjective Tools for Lameness

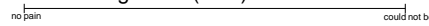
### • Simple descriptive scale (SDS)



### • Numerical rating scale (NRS)



### • Visual analog scale (VAS)



“The magic number seven plus or minus two:  
Some limits on our capacity for processing  
information.”

Miller, 1956

pitch or loudness  
saltiness of a solution  
position of a point on a line  
size of a square

On 101 numerical scale for pain, almost all grouped numbers in multiples of 5 or 10.  
Jensen et al, 1994

#### Holten et al - Findings

- SDS
  - Kappa agreement ranged from 0.21 – 0.37
- NRS
  - Interrater differences accounted for 30-32% of total variability
- VAS
  - Interrater differences accounted for 35-36% of total variability
- Authors concluded variability among veterinarians accounted for large differences in pain scores.

#### Canine Movement Assessment Questionnaire (CMAQ) (Hudson JT et al, 2004)<sup>3</sup>

- Approached lameness as learned avoidance of pain
- 48 lame dogs 3 cohorts (1-2 wks change  $\leq$  10% PVF)
- 10-cm VAS format “more likely to detect subtle changes” vs NRS
- Reduction process 39 questions  $\rightarrow$  19 repeatability  $\rightarrow$  11 in categories of owner assessment, mobility & behavior; questions chosen by regression models of how well they predicted dependent variables of total peak vertical difference, vertical impulse difference & peak propulsion difference

#### Holten et al<sup>1</sup>

- Raters – 3 to 4 veterinarians
- Dogs – 50 post-surgical
- Observed leaving kennel, walking 10 meters, sustained pressure over wound, return to sit or lie down
- All 3 forms of scales completed, various times starting 1 hr post op to next day

#### Quinn et al<sup>2</sup>

- Raters – 1 board-certified surgeon  
2 small-animal surgical residents
- Dogs – 21 tibial osteotomy
- Rated pre-op, 4 & 8 wks post-surgery
- All completed lameness NRS and VAS
- NRS ICCs = 0.30, 0.58, 0.38
- VAS ICCs = 0.24, 0.61, 0.35
- Disappointing interrater reliability

#### Canine Movement Assessment Questionnaire (CMAQ) (Hudson JT et al, 2004)<sup>3</sup>

##### No single force captures lameness

- Play voluntarily predicted total vertical impulse difference
- Stiff when rising predicted total peak propulsion difference
- Forces differed by how dog redistributes when lame and whether acute or chronic

### Canine Brief Pain Inventory (CBPI)

(Brown DC et al, 2007)<sup>4</sup>

- Based upon human Brief Pain Inventory
  - Severity factor – unchanged from BPI
  - Interference factor – adapted to dog behaviors by vets & focus groups
- 11-point NRS, 11 questions
- Test-retest reliability - 70 pet owners of dogs with lameness 2<sup>o</sup> to OA
- Construct validity – Extreme groups comparison with 50 comparable normals ( $p < 0.001$ )
- Convergent validity – Overall QOL vs severity and interference scores
- Excellent test-retest reliability, high internal consistency, construct and convergent validity

### CBPI Follow-Up Studies - Responsiveness

(Brown DC et al, 2008)<sup>5</sup>

- Double-blind RCT
- 70 dogs with OA:
  - 35 carprofen
  - 35 placebo
- Owners completed CBPI
  - Day 0
  - 14-16 days later
- Results for severity and interference scores
  - Carprofen both significant ( $p < .001$ )
  - Placebo no significant change (37% improvement vs 3%)

**CBPI detected improvement in severity & interference scores as well as differences in improvement between groups**

### Comparison of Validated Subjective Instruments

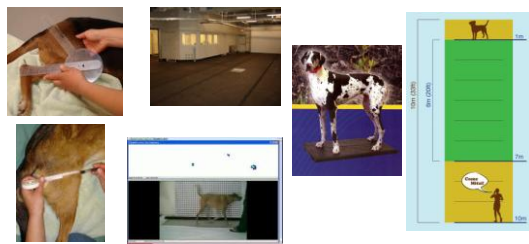
#### Canine Movement Assessment Questionnaire

- Hudson JT et al, 2004
- Owner-completed
- 12 questions
- VAS
- Validated with force plate data

#### Canine Brief Pain Inventory

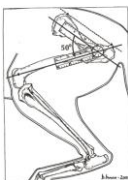
- Brown DC et al, 2007
- Owner-completed
- 11 questions
- NRS (0-10)
- 2-factor: severity and interference
- Convergent validity between scores for 70 dogs with OA vs 50 normal dogs
- Responsiveness ( $p < 0.001$ ) in RCT of 70 dogs with OA

### Objective Tools for Lameness<sup>7</sup>



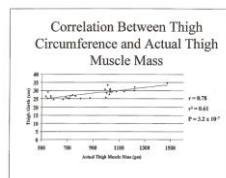
### Goniometry

- Jaegger G et al<sup>8</sup>
  - 16 Labrador retrievers, 3 raters, peripheral joints
    - before and after sedation
    - goniometry vs radiography
  - Intrarater (median variability 3°)
  - Interrater, no sig difference ( $p < .01$ )
  - Goniometry vs radiography, no sig. difference ( $p < .01$ )
  - Awake vs sedation, no sig. difference ( $p < .01$ )



- Benson et al<sup>9</sup>
  - 17 Basset hounds vs 17 Irish wolfhounds
  - Intrarater reliability (ICC3,1) = .99
  - Statistically significant differences between breeds in 8 of 12 joint motions; ie. universal normative tables of limited value

### Girth Measurements



- Millis DL, Scroggs L, Levine D et al.<sup>10</sup>
  - Thigh circumference measured by 2 raters using Gulick-type tape measure
  - Measured standing, flexed & extended at 50% and 70% thigh length; awake vs sedated
  - Interrater within 3.5% of each other
  - Sensitive enough to determine changes within 2 wks of an event that caused min. wt bearing
- Authors recommended:
  - 70% thigh length (from gr troch to lat fabella)
  - stifle extended
  - dog relaxed

## Force Plate Systems

- Camouflaged or embedded FP
- Reaction forces measured in 3 planes
- Most commonly used are frontal:
  - Peak vertical force ( $Z_{max}$  or PVF)
    - Max ground rxn F in stance phase
  - Vertical impulse ( $Z_{impulse}$  or VI)
    - Total force over time
- For lameness discrimination (Evans et al<sup>11</sup>)
  - PVF
  - Falling slope (FS)
    - Rate of unloading

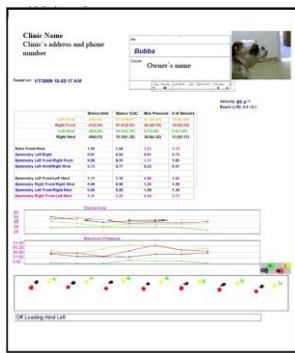
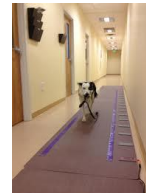
Issues<sup>12</sup>



## Pressure Mat Systems

Example: Gait-4-Dog

- Portability and easy to use
- Immediate feedback
- Captures sequential steps for measuring some variables used in rehab
  - Stance time and Stance %GC
  - Stride Length and Stride time
  - Symmetry of Gait and Center of pressure



## Stationary Balance Systems

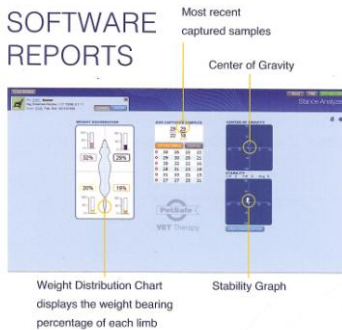
Example: Stance Analyzer

- Post-operative orthopedic/neurologic surgery
- Muscle strains/trauma
- Tendon/ligament injuries
- Osteoarthritis
- Neuropathies
- Degenerative diseases



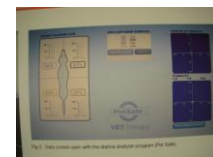
TECHNICAL SPECS	
Length	38 in (96.52 cm)
Width	24 in (60.9 cm)
Height	1.75 in (4.44 cm)
Weight	25 pounds (11.33 kg)
PC Software	XP or above
Screen Resolution	1024x768
Internet Connection	Required for Set up

## SOFTWARE REPORTS



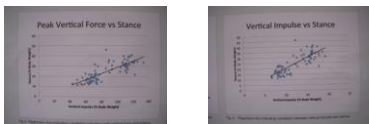
Comparison of weightbearing at a stance vs. trotting in dogs with lameness. Millis D et al.<sup>13</sup>

- Purpose: Compare results of lameness analysis between computerized stance results and force platform results
- Methods:
  - 20 lame dogs
  - PVF and VI as mean of 4 trials of trotting vs static wt bearing (WB)



Millis<sup>13</sup> Cont'd

- Results:
  - Pearson correlation between stance analyzer and PVF/VI = 0.82 ( $p < 0.0001$ )
  - Significant assn between stance WB and PVF ( $R^2 = 0.66$ ;  $p < 0.05$ )
  - Significant assn between WB and VI ( $R^2 = 0.66$ ;  $p < 0.05$ )



- Conclusion:
  - Wt bearing evaluation at a stance compared favorably with force platform findings
  - Suggested that stance analysis was an affordable alternative for objective lameness assessment

Gap in the veterinary rehabilitation literature

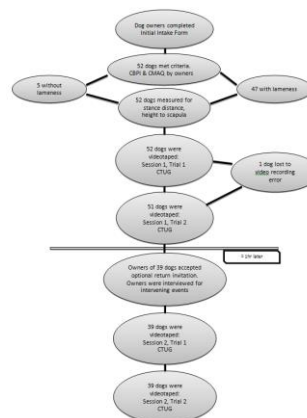


- Lack of objective, functional outcome measures
- Lamoreaux-Hesbach<sup>14</sup>  
*Orthopaedic Physical Therapy Practice, 2003*

Purpose

To determine the psychometric properties of a proposed CTUG test among dogs with lameness of orthopedic origin

- Reliabilities
- Convergent validity
- Minimal detectable change



Dogs

Inclusion Criteria

- Bouts of observable lameness  $\geq 6$  mo.
- Orthopedic primary Dx
- Age  $\geq 18$  mo
- Wt  $\geq 13$  kg (30 lbs)
- Obey owner to lie down, stand up and come



14kg (31lbs)

62kg (137 lbs)

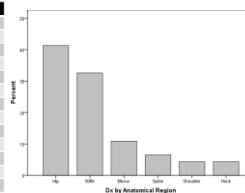
Exclusion Criteria

- Lameness of non-orthopedic origin
- Major change in meds last 6 wks
- Meds within 4 hrs of testing
- Lack of necessary obedience

Dog Diagnoses

Table 1. Primary Veterinary Diagnoses

Diagnosis	N
Hip OA bilateral (7) or unilateral (1)	8
CCL tear, untreated	7
Hip dysplasia bilateral, without OA (6) or with OA (1)	7
CCL tear treated by filament repair (4) or TPLO* (2)	6
Hind limb weakness, etiology unknown	3
Elbow OA	3
Elbow dysplasia	3
Shoulder OA	2
Spondylosis, no neuro-deficit	2
Spondylosis, neuro signs, +/- degenerative myelopathy	1
Amputation midshaft femur	1
Stifle pain of soft tissue origin, Hx subluxing patella	1
Hock contracture s/p infection and debridement	1
Avulsed Achilles tendon, plate and screw fixation	1
No lameness	5



\* Primary etiology, secondary etiologies not listed  
\* Tibial plateau leveling osteotomy

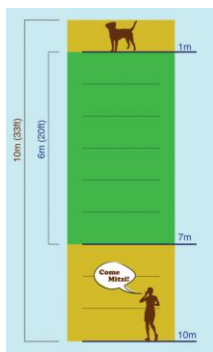


## Raters

- 2 female, 2 male
- Aged 47-63 yrs
- Clinical experience years
- Academic faculty
- Specialty certifications
  - OCS
  - NCS
  - SCS



## Stand Up Event



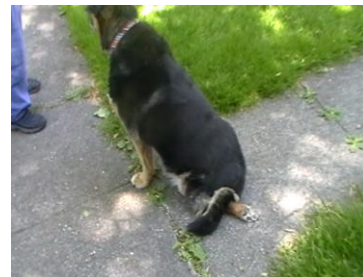
## Statistical Analysis - Reliabilities

- Intra-class Correlation Coefficients (ICCs)
  - Intrarater
    - Shrout & Fleiss<sup>15</sup> ICC (3,1) 2-way mixed model
    - McGraw & Wong<sup>16</sup> "consistency"
  - Interrater
    - Shrout & Fleiss ICC (2,1) 2-way random model
    - McGraw & Wong "absolute agreement"
  - Test-retest
    - Shrout & Fleiss ICC (2,k) 2-way random model
    - McGraw & Wong "absolute agreement"



## Results

- Intrarater reliabilities
  - [ICC(3,1)], consistency **.961 - .999**
- Interrater reliabilities
  - [ICC(2,1)], absolute agreement **.953 - .994**
- Test-retest reliabilities
  - [ICC(2,1)], absolute agreement
    - Gait single trial .855, .887, mean 2 trials **.961**
    - Stand single trial .718, **.318**, mean 2 trials **.771**
    - Total time single trial .878, .741, mean 2 trials **.940**



## Significance of CTUG Correlations with the Four Validity Criteria

Criterion	Stand Up p-value	Gait p-value	Total Time p-value
CMAQ Total Score	p=.001	p<.001	p<.001
CBPI Severity Score for last 7 days	p=.007	p=.002	p=.003
CBPI Interference Score for last 7 days	p=.001	p=.006	p=.001
CBPI Total Score	p=.001	p=.001	p=.005

\* Kendall's tau used for all correlations  
† Sample limited to dogs within 1 standard deviation for height and weight  
Abbreviations: CMAQ, Canine Movement Assessment Questionnaire; CBPI, Canine Brief Pain Inventory

Validity – highest correlations at  $p < .001$ 

- Stand up event – physical function
  - CMAQ: overall assessment, happy dog postures, morning stiffness standing up
  - CBPI: abilities to stand, walk, run, climb stairs/curbs
- Gait event – pain, quality of life
  - CMAQ: overall assessment, happy dog postures, willingness to play, exercise frequency, morning stiffness standing up, lameness at a walk, pain with turning suddenly
  - CBPI: worst pain, average pain, overall quality of life



## Limitations

- Appropriate at level of the individual?
- Responsiveness?
- Able to discriminate between normal gait and minimal lameness?
- Generalizability
  - Lameness from neurologic, immunologic, infectious or neoplastic conditions excluded



## Conclusion

The CTUG is an appropriate tool to objectively measure changes in lameness of orthopedic origin at the group level.

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## Canine Brief Pain Inventory (CBPI)

(Brown DC et al, 2007)<sup>4</sup>

- Based upon human Brief Pain Inventory
  - Severity factor – unchanged from BPI
  - Interference factor – adapted to dog behaviors by vets & focus groups
- 11-point NRS, 11 questions, owner-completed
- Test-retest reliability - 70 pet owners of dogs with lameness 2" to OA
- Construct validity – Extreme groups comparison with 50 comparable normals ( $p < 0.001$ )
- Convergent validity – Overall QOL vs severity and interference scores
- Excellent test-retest reliability, high internal consistency, construct and convergent validity

Use of CBPI for assessment of severity and severity of chronic pain and treatment for dogs with osteoarthritis and for bone cancer is valid, reliable and responsive. It is copyrighted but permission to use it can be requested at [www.CanineBPI.com](http://www.CanineBPI.com) or [dottie@vet.upenn.edu](mailto:dottie@vet.upenn.edu)

## CTUG Protocol – Stand Up Component

- Start position - lying down with lower abdomen in contact with ground & fore limbs outstretched
- Timing starts when dog initiates upward movement
- Timing stops when limbs are extended to the dog's habitual stance position. Timing continues to completion even if several tries are required to achieve standing.
- For this event, the average of 2 trials per session is recommended for test-retest reliability

## Canine Movement Assessment Questionnaire (CMAQ)

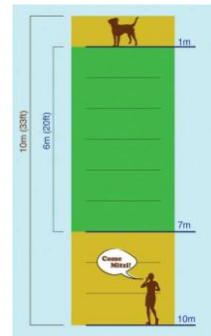
(Hudson JT et al, 2004)<sup>3</sup>

- Approached lameness as learned avoidance of pain
- Developed on 48 lame dogs
- 10-cm VAS format, 12 questions, owner-completed
- Validated by how well predicted dependent variables of total peak vertical difference, vertical impulse difference & peak propulsion difference

Use of CMAQ for assessment of pain and lameness among dogs with orthopedic lameness is reliability and valid based upon force plate data. Permission can be requested from Margaret Slater at [margaret Slater@aspca.org](mailto:margaret Slater@aspca.org) or [m Slater@cvm.tamu.edu](mailto:m Slater@cvm.tamu.edu). The study: Hudson JT, Slater MR, Taylor L et al. Assessing repeatability and validity of a visual analogue scale questionnaire for use in assessing pain and lameness in dogs. *Am J Vet Res*. 2004;65(12):1634-1643.

## Canine Timed Up & Go (CTUG) – General Rules

- Materials: basic stopwatch, marking tape or chalk/paint
- Participants: dog, owner/motivator, tester
- 2 discrete subtasks: stand up & gait (lie down found to be invalid)
- Timing begins with movement in the appropriate direction rather than with command.
- Practice trial unnecessary (no learning effect found)
- Interrater reliabilities for both components
  - ICC(2,1), absolute agreement .953-.994
- Test-retest reliabilities (mean of 2 trials)
  - ICC(2,1) gait .961; stand up .771; total time .940
- Validity
  - $P < .006$  for correlations with all criteria: Canine Movement Assessment Questionnaire Total Score, Canine Brief Pain Inventory Severity Score, Interference Score, Total Score



## CTUG Protocol – Gait Component

- A narrow, non-slippery track consists of taped lines at 1,7,10 meter marks. Actual distance timed is 6 m.
- Start position - Tester holds standing dog behind 1m mark.
- Owner/motivator stands behind 10m mark. This prevents deceleration before 7m mark.
- Owner/motivator chooses communication – verbal, hand gestures, incentive treats- as long as consistent
- Timing starts when dog initiates self-paced, forward movement. Unleashed or slack leash.
- Timing stops when first paw crosses the 7m mark.
- For this event, only 1 trial per session is necessary for test-retest reliability