Projected Cost Savings of Implementing Video-oculography for Diagnosis of Dizziness in US EDs

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Dizziness and vertigo lead to 4 million US emergency department (ED) visits annually at a cost of $4 billion.[1] Hundreds of millions of dollars are spent on neuroimaging trying to detect the ~5%[2-7] of patients who have life-threatening posterior fossa strokes causing their dizziness or vertigo—yet one-third of these vestibular strokes are missed.[2,8] In addition, most of the ~1 million dizziness and vertigo patients with benign inner ear causes are over-tested,[9] misdiagnosed,[10] and undertreated.[11] Accurate and efficient diagnosis will save lives through prompt and appropriate treatments while reducing costs and harms by eliminating inappropriate over-testing. Our approach to diagnosis of ED dizziness uses device-based measurement of acute oculomotor physiology by portable video-oculography (VOG), the conceptual equivalent of an 'EKG' machine for acute dizziness.[12]

Our team is experienced in US national resource utilization and economic analyses for ED dizziness.[1,4,9,13-15] For high-risk patients, VOG would save lives via improved stroke care (Figure). For low-risk patients, VOG would save ~$1 billion per year by safely reducing testing (Tables). **Thus, VOG would save lives and money**.

We have modeled the benefits in quality-adjusted life years of more accurately diagnosing and treating strokes at the initial ED visit and find that we can substantially improve patient safety and patient outcomes at very reasonable cost by promptly diagnosing vestibular strokes and correctly applying currently-available stroke treatments (Figure).[14] We modeled cost-effectiveness of our novel approach,[14] focusing on variable costs and effects related to diagnosis of strokes among ED patients with acute, continuous dizziness (~15% of all ED patients with dizziness or vertigo, and who are at highest stroke risk). We compared two general, routine diagnostic strategies (MRI all, admit all) to current practice and our proposed strategy (bedside VOG to inform decision-making). We used national prevalence and utilization data[4,9] and diagnostic accuracy estimates[17] from our prior studies. We did not consider fixed costs of diagnostic or hospital equipment. We calculated incremental cost-effectiveness ratios (ICERs) from a societal perspective using dollars and quality-adjusted life years (QALYs).

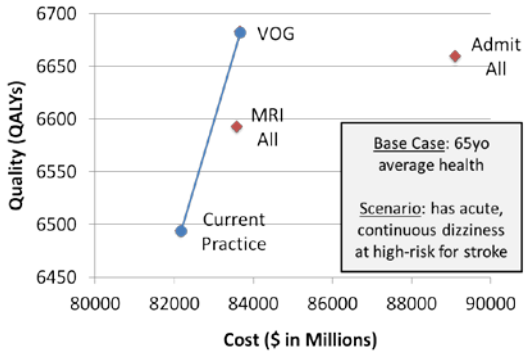

Figure. VOG will be cost-effective in patients at high stroke risk. VOG could save many lives and is highly cost-effective (~$7,735 per QALY) in this subset of patients, given $50,000-$100,000 is a conservative estimate for the value to society of a QALY.[16] *Blue-non-dominated. Red-dominated.*

Projected cost savings from implementing VOG-based diagnosis for ED dizziness derive predominantly from reducing brain CT overuse and eliminating unnecessary admissions for benign inner ear conditions. CTs are insensitive for stroke and rarely indicated in ED dizziness.[1] Greater CT use does not improve diagnosis.[15,18] Inner ear diseases should be diagnosed by bedside eye movement assessment,[19] which can be done by VOG. When imaging is required to search for stroke, the correct imaging test is brain MRI, not CT.[1] Cost savings are counterbalanced partially by an increase in appropriate brain MRI use to improve stroke detection, but **the net savings are projected to be $0.5 – 1.5 billion annually** in workup costs for ED dizziness, approximately 35% of which are borne directly by Federal and State public insurance programs such as Medicare and Medicaid.[4]

Table 1. Cost savings of implementing VOG approach nationally using variable projections of effects on physician behavior

For All ED Dizziness	Current (2013 US National[1,4])	Conservative Projection	Intermediate Projection	Optimistic Projection
ED CT Reduction from Current Baseline	0%	50%	75%	90%
All ED Dizziness CT Rate	41.2%	20.6%	10.3%	4.1%
ED MRI Increase from Current Baseline	0%	50%	25%	0%
All ED Dizziness MRI Rate	2.4%	3.6%	3.0%	2.4%
Anticipated Admit Rate Reduction for Ear Disorders	0%	25%	50%	75%
All ED Dizziness Admission Rate	18.8%	18.0%	17.2%	16.4%
Total ED/Hospital Workup Costs	**$9,242,624,941**	**$8,703,997,576**	**$8,198,729,820**	**$7,735,623,708**
Total Annual US Healthcare Cost Savings	**$0**	**$538,627,365**	**$1,043,895,121**	**$1,507,001,233**
Public (Federal/State) Insurance Cost Savings	**$0**	**$186,903,696**	**$362,231,607**	**$522,929,428**

Table 2. Parameter estimates (with sources cited) for cost savings calculations elaborated in Table 1

PARAMETER	VALUE
Total ED dizziness visits national estimate for 2013[1]	4,135,000
Stroke fraction of all ED dizziness[2-7]	5.0%
Symptom-only diagnosis (ICD-9 780.4) fraction of all ED dizziness[4]	22.1%
Symptom-only diagnosis (ICD-9 780.4) current admission rate[9]	11.8%
Peripheral vestibular fraction of all ED dizziness[9]	7.4%
Peripheral vestibular current admission rate[9]	8.3%
CMS 2012 payment average CT brain (without or with contrast)[20]	$315
CMS 2012 payment typical stroke protocol MRI brain[21]	$1,204
Average total Medicare payment per hospital discharge (all DRGs)[22]	$11,205
Fraction of ED dizziness patients using US Federal/State government health insurance[4]	34.7%

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