# Cost-Quality Efficiencies: An Illustration of Data Envelopment Analysis for Mental Health Delivery

Presented to The 19th Annual Research Conference – A System o Mental Health: Expanding the Research Base Tampa Martiott Waterside, Tampa, Florida February 23, 2006 By L. Own Fillman, Dr.P.H., MHA.

Child and Adolescent Mental Health Division (C 3627 Kilauea Avenue, Room 101 Honolulu, HI 96816 Phone: 808.733.4210 E-mail: tofilma@camhmis.health.state.hi.us



**Our Mission**Happy Children
Healthy Families
Helpful Communities









### 19th Annual RTC Conference Presented in Tampa, February 2006









## DEA in Healthcare Administration Literature

### Hospital Operating Room

What is the growth potential for hospital operating room services? (O'Neill & Dexter, 2005)



### DEA in Healthcare Administration Literature

#### Physician Practice Administration

What are the best practices of an efficient group practice office? (Andes et al., 2002).



Long-Term Care

Is there an association between quality of care and technical efficiency in the long-term care units? (Laine et al., 2005)



## **DEA in Healthcare** Administration Literature

oital-to-Hospital Compariso

What are the opportunities for realignment of resources within the Veteran's Health **Administration Hospitals?** (Harrison & Ogniewski, 2005)

What would happen if hospital budgets were based on expected efficiencies? (Biorn, Hagen, Iversen, & Magnussen, 2003)



What are the cost inefficiencies in the residential care services for the mentally disabled? (Blank & Valdmanis, 2005)



## **DEA in Healthcare Administration** Literature

Health System Evaluation •

Which federal hospital system is more efficient? The Department of Defense hospitals or the Veterans'

## SELECTED **DEMOGRAPHICS** of **CAMHD DEA:**

**OCTOBER 2004 through MARCH 2005** 





























Percentage of treated youth with no documented complaint or 20%	es
grievance 20% 10%	98%

			Dat	ta (	Su	m	ma	ry		
			JAL ITPI	ITY JTS	RE INI	SC PU	UR IS	CE		
Center	In-Hm Tx %	CSP @ Std %	Scores Improving %	No Complaint or Grievance %	Ave Off Exp/Ave Client Day/Mo	Ave Salary/ Ave Cl Day/Mo	Average MHCC FTE's/Ave CI Days/Mo	Ave Costs for Clinical Services/ Ave Cl days/ Mo (Elec Inv's)	Average Out-of Home Costs/ Ave CI Day /Mo (Elec Inv's)	
A	Α	94.6	84.0	100.0	\$0.64	\$34.40	0.0541	\$91.88	76.52	1
		87.3	64.3	100.0	\$0.71	\$51.65	0.0593	\$100.01	76.37	
		92.8	67.0	98.5	\$0.90	\$37.39	0.0457	\$106.36	93.73	
D		91.8	63.4	99.7	\$0.99	\$57.09	0.0647	\$109.50	86.23	
	09.3	85.0	72.9	98.4	\$1.64	\$46.72	0.0536	\$72.35	53.98	/
F	58.8	80.7	66.7	99.8	\$1.18	\$36.85	0.0459	\$81.53	69.35	ľ
	= 1	Highe	st/Vari	iable		= 1	owes	t/Variab	le	







decision support tool for the administration of an evidence-based mental health delivery system.







<u>Step 1</u>: Set Up The Excel Worksheet with Cells for 1) Output Data, 2) Input Data, 3) Output Values, 4) Input Values, 5) Output Weights and 6) Input Weights

	A	B	C		D	E	F	G	н	1	J	2	
1		N		1	DEA O	UTPUT A	ND INPU	TADATA:	OCT 200	4 MARCH	1 2005	3	4
2													
3	_	7	ΟΠΑΙ	ITY O	UTPUT	s	-		RESOURCE	NPUTS			
· ·	- 1		4,01112								1		
	Yariable Description	in-Hm Tz X	CSP @ Std %	Se Impi	ores roving %	No Complaint Or Grievance %	Ave Off Exp/Ave Client Dag/Mo	Ave Salary/ Ave Cl Day/Mo	Average MHCC FTE's/Ave CI Dags/Mo	Ave Costs for Clinical Services! Ave Cl dags! Mo (Elec Inv's)	Average Out-of Home Costs/ Ave CI Day IMo (Elec Inv's)	Value of Outputs: Sum of Variable X Veight	Value of Inputs: Sum of Variable X Veight
5	Office/ Yariable	X1	X2	;	K3	X4	Y1	Y2	Y3	¥4	Y5		
6	A	67.1	94.6		1.0	100.0	\$0.64	\$34.40	0.0541	\$91.88	76.52	0.841	0.841
7	B	70.3	87.3	-	.3	100.0	\$0.71	\$51.65	0.0593	\$100.01	76.37	0.841	0.853
8	C	56.0	92.8	6	.0	98.5	\$0.30	\$37.39	0.0457	\$106.36	93.73	0.828	1.053
9	D	65.3	91.8	-	.4	99.7	\$0.99	\$57.09	0.0647	\$109.50	86.23	0.838	1.000
10	E	69.3	85.0		.9	98.4	\$1.64	\$46.72	0.0536	\$72.35	53.98	0.828	0.828
11	E	58.8	80,7		.7	99.8	\$1.18	\$36.85	0.0459	\$81.53	69.35	0.839	0.879
12			$\sim$		_								
13	$\sim$			$\sim$									
14	Output Ve	ights	Inpu	t ¥eig	hts								
15	21+	3.9E-07	¥1+	0.196	980538								
16	×2 =	0	Y2:		0								
17	X3 =	3.9E-07	Y3:		0								
18	X4 =	0.00841	Y44		0								
19			Y8+	0.003	9333M7								
20													
- 24		_	-		_								

<u>St</u> Fc	brmul	: D la I	efi Pati	ne ti tern +89 <sup>+</sup> B15++		utp w	9*B18 ,	alue	es Us	ing t	he	
	A	В	U	DEA O			T DATA-	OCT 2004	MARCH	2005	К	
2		_	_	DLA U	OTFOTAL	DINFO	DATA.	011 2004	· MARCI	2003		
3			QUAL	TY OUTPUT	s			RESOURCE	NPUTS			
4	Variable Description	in-Hm Tx X	CSP @ Std %	Scores Improving Z	No Complaint or Grievance X	Ave Off Exp/Ave Client Dag/Mo	Ave Salary/ Ave Cl Dag/Mo	Average MHCC FTE's/Ave Cl Dags/Mo	ere Costs for Clinical Ser Joes/ Ave 11 days/ M (Elec Inv's)	Average Out-of Home Costs/ Ave CI Day /Mo (Elec Inv's)	Value of Outputs: Sum of Variable X Veight	Value of Inputs: Sum of Variable X Veight
5	Office/ Variable	X1	X2	X3	X4	¥1	¥2	Y3	¥4	5		
6	A	67.1	94.6	84.0	100.0	\$0.64	\$34.40	0.0541	\$91.88	76.5	0.841	0.841
7	в	70.3	\$7.3	64.3	100.0	\$0.71	\$51.65	0.0593	\$100.01	76.37	0.841	0.853
8	ç	56.0	92.8	67.0	98.5	\$0.30	\$37.39	0.0457	\$106.36	\$3.73	0.828	1.053
3	0	65.3	31.8	63.4	39.7	\$0.99	\$57.09	0.0647	\$109,50	86.23	0.838	1.000
10	E	63.3	85.0	12.3	36.4	\$1.64	\$90.72	0.0536	\$72.35	53.36	0.020	0.020
12			- 00.F	99.7	99.0	¥4.10	400.00	9.9100	401.00	99.39	0.000	9.919
13												
14	Output Ve	ights	Inpu	Veights								
15	X1+	3.9E-07	91.	0.196980538								
96	1/2 =	0	¥2:	0								
1/	X3 *	0.02041	7.38	3								
23		0.00041	75.	0.005030147								
20			10-									
690												



# 19th Annual RTC Conference Presented in Tampa, February 2006

	A	В	c	DEA				H T 2004 - N	APCH	1	1	к	L
				DEAC				1 2004 - N	ench i				
2			OUALITY	OUTPUTS				DECOUDO	C IMPII	те		-	<u> </u>
-			quarter	0011 013				Areroa	Are Ce	ate for	American Onto		
					Ha	Are 0((	A	Antings	And Co	Ical	of Home	Value of Outputc:	Value - Inputs
	Note	: Th	e las	st coi	nstra	lint is	en	tered		cl Mo	Costs/ Ave Cl Day /Mo (Elec	Sum of	Sun o
4	ac K	C.K4	4	1.6.1	44	Tho n				lav's)	lav's)	Variable X Weight	Variabl
	as n	0.11		LOIL		i ne p	Ug	ram					
5	auto	mati	cally	/ cha	naed	thos	e v:	alues	.	4	¥5		
6									•	88	76,52	0.841	0.04
		νατρυ	ιτ5 <	= inp	uts".					0.01	76,37	0.841	0.85
3		Jutpu	τ5 <	= Inp	uts".					.01 .36 .50	76.37 93.13 86.23	0.841 9.828 0.838	0.85
3		69.3	85.0	= Inp	98.4	11.64	\$46.72	0.0536	\$70	0.01 .36 1.50 2.35	76,37 93,14 86,23 53,35	0.841 0.828 0.838 0.828	0.85
8 9 90 11		69.3 50.0	85.0 00.7	72.9 66.7	98.4 93.0	\$1.64 \$1.10	\$46.72 \$36.05	0.0536	\$72 \$01	1.01 .36 1.50 2.35 1.53	76,37 03,15 86,23 53,35	0.841 0.828 0.838 0.828 0.833	0.85
8 9 10 11 12 13		69.3 50.0	85.0 89.7 = Nigkest 0 = Lowest 0	72.3 66.7 Aparts Aparts	98.4 93.0 Solver	si.to si.to r Paramete	\$46.72 \$36.05	0.0536	\$72 \$01	1.01 .36 150 2.35 1.53	76.37 53.19 86.23 53.31 7.35	0.841 0.828 0.838 0.828 0.833	0.85
8 10 11 12 13 M	E F Output V	69.3 50.0	85.0 89.7 : Nigkest ( Lowest C lapet	T2.3 66.7 Apers Meas Velights	98.4 33.0 Solver	stor stor r Paramete	\$46.72 \$36.05 215	0.0536 0.0453	101 101	1.01 .36 150 2.35 1.53	76.37 19 74 86.23 53.35	0.841	0.85
8 9 0 11 12 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15	E F X1: X2:	69.3 50.0 /4ighte 3.8776E-07	85.0 89.7 : Nigkest ( : Lowest ( laput	= Inp 72.3 66.7 Apris News Velgite 0.13053605	38.4 33.0 Solver	r Paramete	\$46.72 \$16.05 275	0.0536 0.0453		01 .36 .0 .35 .53	76.37 19.16 86.23 53.35	0.841 9.828 0.838 0.039	0.83 1.05 1.00 0.02 0.07 7
8 8 11 12 13 14 15 16 16 17 17 17 17 17 17 17 17 17 17 17 17 17	E F X1: X2: X2: X2:	69.3 50.0 Alighte 3.0776E-07 0.3.0776E-07	85.0 89.7 = Highest ( = Lowest ( heput Y Y	= Inp 72.3 66.7 Apris fices Veighte 0.1963005 0 0	38.4 33.0 Solver Set Ta	r Paramete arget Cel:	\$46.72 \$36.05 \$15	0.0536 0.0453	111 10	1.01 .36 130 2.35 1.53	76.37 29.10 86.23 53.34 53.35	0.841 9.828 0.838 0.033	0.83 1.05 0.02 0.07 2.07
8 9 10 11 12 11 14 15 16 17 19	E F X1: X2: X2: X4:	69.3 50.0 3.07162-01 0.00040532	85.0 89.7 = Nighest ( = Lowest () Ny Y	= Inp 72.3 66.7 April faces Veighte 0.106.0005 0 0 0 0 0	98.4 39.0 Solver Set Ta Equal	r Paramete arget Cell: To: (• )	146.72 136.05 275	0.0536 0.0453 9 3.		1.01 1.36 1.53	76.37 86.23 53.35	0.841	0.63 1.05 1.00 0.02 0.01 20hre
8 3 90 11 12 13 14 15 16 17 18 19 19 19 19 19 19 19 19 19 19 19 19 19	E F X1: X2: X2: X4:	69.3 50.8 Alighte 3.0716E-01 0.00040532	85.0 80.7 = Highest = Lowest G ispet Y Y Y Y	= Inp 72.9 66,7 Apers Neighte 0.9503055 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	98.4 23.0 Solve Set Ta Equal By Ch	r Paramete arget Cell: To: (* j hanging Cells:	946.72 136.03 275	0.0536 0.0459 9 Min	C Valu	1.01 .36 10 2.35 1.53	76.37 86.23 53.33 .35	0.841	0.63 1.05 1.05 0.02 0.07 20/ve
8 9 11 12 13 15 15 17 19 10 20 21 20 21 20 21 20 21 20 21 20 20 20 20 20 20 20 20 20 20	E F X1= X2= X3= X4= Efficiency = Z =	69.3 50.0 3.0716E-07 0.00040632 0.00040632	85.0 80.7 = Nigkest = Lowest C ispet Y Y Y Y	72.3 66.7 fpets 0.1963005 0 0.00000005 0.00000000000000000000	98.4 23.0 Solver Set Ta Equal By Ch	r Paramete arget Cell: To: (• ) hanging Cells:	146.72 136.03 15	0.0536 0.0459 9 Min	C Valu	2.01 .36 2.35 1.53	26.37 86.23 53.35 7.55	0.841 -0.828 -0.833 -0.828 -0.828 -0.828 -0.828 -0.828 -0.828 -0.828 -0.828 -0.828 -0.828 -0.835 -0.828 -0.835 -0.828 -0.835 -0.828 -0.848 -0.	0.05 1.05 1.05 0.02 0.02 0.02 0.02
8 9 10 11 12 13 15 16 17 19 19 20 21 21	E F Vite Vite Vite Vite Vite Vite Vite Vite	69.3 50.0 *ightc 3.0776E-07 0.000640532 0.000640532	85.0 09.7 : Highert : Lowert Hapet Y Y Y Y Y	- Inp 72.9 66.7 7pers Vigitz 0.1953005 0 0 0 0 0 0.00030301	98.4 23.0 Solver Set Ta Equal By Ch \$8\$	1000           \$1.10           r Paramete           arget Cell:           To:         •             hanging Cells:           15:\$8\$\$18,\$0;	\$46.72 \$36.05 \$75 \$38 \$46.72 \$72 \$36.05 \$75 \$36 \$36 \$36 \$36 \$36 \$36 \$36 \$36 \$36 \$36	0.0536 0.0453 9 <b>1</b> 0 Min 19	C Valu	2.01 .36 .35 1.53 1.53	16.37 86.23 55.35 0 0	0.841 	1.05 1.05 1.05 0.02 0.02 20/ve Close
8 9 9 11 12 13 14 15 15 15 15 15 15 15 15 15 15	E F X1: X2: X4: X4: X4: X4:	69.3 50.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	85.0 00.7 :Ngbert :Lowert N Y Y Y Y Y Y P P	72.3 66.7 4pers 10.0503005 0 0 0 0.00030301	98.4 93.0 Solver Set Ta Equal By Ch [\$8\$	r Paramete arget Cell: To: (* ) hanging Cells: 15:\$8\$18,\$0	\$46.72 136.05 275 132 132 132 132 132	0.0536 0.0459 9 Mg 19	C Valu	2.01 .36 50 2.35 1.59	0 <u><u><u><u></u></u><u></u><u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u></u></u>	0.841 -0.828 -0.928 -0.	0.05 1.05 1.05 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0
8 3 10 11 12 10 13 15 16 17 10 10 20 21 22	E F X11 X12 X12 X12 X12 X12 X12 X12 X12 X12	69.3 50.0 3.0776E-01 0.00040592 0.03050107 Efficiency	85.0 89.7 =Highest =Lowest hepet Y Y Y Y Y Y Efficience	- Inp 72.9 66.7 8945 0.1553505 0 0 0.0033331	98.4 39.0 Solve Set Ta Equal By Ch [\$8\$: -Subje	r Paramete state arget Cell: To: (* ) hanging Cells: 15:\$8\$18,\$0; sct to the Cor	\$46.72 136.05 275 138.05 275 275 138 138 15:\$D\$	0.0536 0.0453 9 3. C Min 19	C Valu	2,01 ,36 5,0 1,53 1,53 1,53	0 <u>Guess</u>	0.841	201ve
8 9 10 11 12 13 14 15 16 16 16 16 16 16 16 17 16 16 16 17 16 16 17 16 17 16 18 17 17 18 18 18 19 19 10 10 10 10 10 10 10 10 10 10 10 10 10	E F Niz Xiz Xiz Xiz Xiz Efficiency z Zz	69.3 50.0 2.07765-01 0.000406320 0.000406320 0.000406320 0.000406320 0.000406320 0.000406320 0.000406320	85.0 80.7 1054 1055	- Inp 72.9 66.7 Vilate 0.995005 0.0 0.00030301	98.4 33.0 Solver Set Ta Equal By Ch [\$B\$: Subject	r Paramete arget Cell: To: • hanging Cells: 15:\$8\$18,\$0; st: to the Cor	\$46.72 \$36.05 \$75 \$15 \$15:\$D\$ sstraints	0.0536 0.0459 S Mb 19		e of:	0 <u>Guess</u>	0.844	jolve zolve
5 6 7 8 9 1 2 3 5 6 7 8 9 10 11 12 3 5 6 7 10 11 12 3 5 6 7 10 11 12 3 5 6 7 7 10 10 10 10 10 10 10 10 10 10 10 10 10	E F X1: X2: X4: Efficiency::2: Conter + H S	69.3 50.0 50.0 50.0 0 3.00765-01 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.000407	ency	- Inp 72.3 66,7 Apers 0.00000000 0.000000000000000000000000	96.4 29.0 Solve Sgt Tz Equal By Ct [\$88: -Subje Z. [\$88:	r Paramete arget Cell: To: (* ) hanging Cells: 15:\$8\$18,\$0: sct to the Cor 15:\$8\$18 >=	115:104 115:104 115:104 115:104	0.0536 0.0453 9 Min 19	Statu Statu	2.35 2.35 1.53	0 <u>G</u> uess	0.841 0.828 0.833 0.833 0.833 0.833	jolve zolve
	E F Xi= Xi= Xi= Xi= Xi= Xi= Xi= Xi= Xi= Xi=	69.3 50.0 2.07705-01 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632 0.00040632	BS.0 00.7 19594cm ( Lowerto Ispat Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y	= Inp 72.3 66.7 7ets 0.3523005 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	98.4 29.0 Solver Set Ta Equal By Ct \$89 Subject \$89 Subject \$89 Subject \$89 Subject \$89 Subject \$89 Subject \$80 Subject Subjec	1100           \$1.10           r Paramete           arget Cell:           To:         (*)           hanging Cells:           15:\$8\$18,\$D;           sct to the Cor           15:\$8\$18,\$D;           stt to the Cor           15:\$8\$18,>=	146.72 136.05 175 175 15:10 15	0.0536 0.0453 9 <b>1</b> 0 Min 19	tra to C ⊻alu	.01 .36 .50 2.33 153 	0 <u>A</u> dd		jolve Close
	E F XIII XIII XIIII XIIII XIIII XIIII XIIII XIIIII XIIIII XIIIII XIIIIII	69.3 50.0 741gAtc 0.00840592 0.00840592 0.00840592 0.00840592 0.00840592 0.00840592 0.00840592 0.00840592 0.00840592	85.0 00.7 = Nighers Lowerto NY Y Y Y Y P Efficience Diate for		30.4 30.4 30.0 Solver Sgt Ta Equal By Ch \$883 \$895 \$05 \$10 \$05 \$10 \$10 \$10 \$10 \$10 \$10 \$10 \$10 \$10 \$10	Ite4           31.10           r Paramete           arget Cell:           To:         ●           to:         ●           to:         ●	116.05 126.05 175 138 15:10 15:10 15:10 15:10 10 10 10	0.0536 0.0453 9 <b>5</b> C M <u>p</u> 19	So So C Valu	.01 .36 .35 .35 .35 .53	0 <u><u><u></u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u>		jolve jolve

<u>St</u> th Re	e "Final e "Final peat St	ead the F Value" F eps 2 – 5	Relative field as i for Othe	Efficien dentifie er Cente	cy Va d bel ers	lue From ow.
	E8 -	f≈ 0.83792893	7813046			
	A B	C	D	E	F	G
1	Microsoft Excel	10.0 Answer Repo	rt			
2	Worksheet: [FG0	CDEA Oct 2004 - M	lar 2005-With Out	of Home Place	mentsl.xls]	Solver Template
3	Report Created:	10/15/2005 11:38:0	7 PM			
4						
5					4	
6	Target Cell (Max)					
1	Cell	Name	Original Value	Final Value	Eff	iciency
8	\$K\$9	Value of Outputs	0.99	0.8379	of	Center D
9						
10						
11	Adjustable Cells					
12	Cell	Name	Original Value	Final Value		
13	\$B\$15 X1 = X1		0	0		
14	\$B\$16 X2 = X1		0.009028626	0		
15	\$B\$17 X3 = X1		0.00040474	0.000.007.000		
16	\$8\$18 X4 = X1		0.001648174	0.008407502		
17	\$D\$15 Y1 = X	5	8.6168/E-05	0.196982548		
10	3U310 Y2= X3		0.00123452	0		
19	\$D\$17 Y3= X3		11.812306	0		
	auaio ĭ4= X3		U	U		

This Table Illu Relative Efficiency o Ou	strates the Ca of Center D Usi tputs and Weig	lculation of t ing Solver-Ge jhts	he enerated
OUTPUT VARIABLES	OUTPUTS	WEIGHTS	PRODUCT
X1 = In Hm Tx %	65.3	0.0000	0.0000
X2 = CSP at Std %	91.8	0.0000	0.0000
X3 = Scores Imp %	63.4	0.0000	0.0000
X4 = No Complaint %	99.7	0.0084	<u>0.8379</u>
	The DEA for	Center D	SUM 0.8379
	INDUTS	WEIGHTS	PRODUCT
INPUT VARIABLES	INFUIS		FRODUCT
Y1 = Off Exp	0.99	0.1970	0.1952
Y1 = Off Exp Y2 = Sal Exp	0.99	0.1970	0.1952
Y1 = Off Exp Y2 = Sal Exp Y3 = MHCC FTE's	0.99 57.09 0.0647	0.1970 0.0000 0.0000	0.1952 0.0000 0.0000
Y1 = Off Exp Y2 = Sal Exp Y3 = MHCC FTE's Y4 = Clinical Exp	0.99 57.09 0.0647 109.50	0.1970 0.0000 0.0000 0.0000	0.1952 0.0000 0.0000 0.0000
Y1 = Off Exp Y2 = Sal Exp Y3 = MHCC FTE's Y4 = Clinical Exp Y5 = OOH Exp	0.99 57.09 0.0647 109.50 86.23	0.1970 0.0000 0.0000 0.0000 0.0093	0.1952 0.0000 0.0000 0.0000 <u>0.8048</u>
Y1 = Off Exp Y2 = Sal Exp Y3 = MHCC FTE's Y4 = Clinical Exp Y5 = OOH Exp	0.99 57.09 0.0647 109.50 86.23	0.1970 0.0000 0.0000 0.0000 0.0093	0.1952 0.0000 0.0000 0.0000 0.8048 SUM 1.0000