

## Supplemental Materials

### **Estimating the Real-World Cost of Diabetes Mellitus in the United States During an 8-Year Period Using 2 Different Cost Methodologies**

Vincent J. Willey, PharmD; Sheldon Kong, PhD; Bingcao Wu; Amit Raval, PhD; Todd Hobbs, MD; Andrea Windsheimer; Gaurav Deshpande, MS, PhD; Ozgur Tunceli; Brian Sakurada; Jonathan R. Bouchard, MS, RPh

This Appendix has not been edited and is provided as supplemental materials for this article, which was published in *American Health & Drug Benefits* in September 2018.

**Supplemental Table 1. Comorbid conditions and complications of T1DM and T2DM in the US, 2007 - 2014**

		Cohorts							
		2007	2008	2009	2010	2011	2012	2013	2014
<b>Type 1 Diabetes Mellitus</b>									
Sample size of T1DM, n		23,073	24,683	26,228	26,164	25,876	24,986	23,881	21,176
DCI	T1DM	2.3	2.4	2.4	2.4	2.5	2.6	2.6	2.5
	Controls	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
ADCSI	T1DM	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.1
	Controls	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
<b>Comorbid Conditions of T1DM</b>									
Hypertension	T1DM	55.3%	57.4%	58.3%	59.5%	60.0%	63.6%	62.7%	61.8%
	Controls	28.1%	29.5%	29.6%	29.9%	30.5%	32.7%	32.7%	32.4%
Dyslipidemia	T1DM	54.0%	57.4%	59.2%	60.9%	61.1%	65.2%	65.3%	65.5%
	Controls	27.8%	29.6%	30.3%	30.8%	32.1%	33.6%	32.9%	32.7%
<b>Microvascular Complications of T1DM</b>									
Retinopathy	T1DM	34.2%	33.4%	32.9%	32.3%	31.9%	33.1%	32.3%	32.1%
	Controls	1.4%	1.5%	1.6%	1.6%	1.7%	1.9%	2.0%	2.2%
Nephropathy	T1DM	19.4%	20.3%	20.5%	20.4%	20.9%	22.2%	22.0%	22.0%
	Controls	1.9%	2.1%	2.2%	2.3%	2.5%	3.0%	3.1%	3.3%
Neuropathy	T1DM	28.6%	29.0%	29.5%	29.5%	30.2%	31.9%	32.2%	32.4%
	Controls	3.5%	3.8%	3.9%	4.0%	4.0%	4.6%	4.5%	4.7%
<b>Macrovascular Complications of T1DM</b>									
IHD	T1DM	22.6%	23.1%	23.0%	22.4%	22.3%	23.8%	22.6%	21.4%

	Controls	6.9%	7.0%	6.9%	6.9%	6.9%	7.5%	7.2%	7.4%
PVD	T1DM	16.3%	16.8%	16.8%	16.8%	17.0%	18.2%	17.7%	16.5%
	Controls	1.8%	2.0%	2.0%	2.0%	2.0%	2.4%	2.1%	2.1%
CVD	T1DM	10.1%	10.3%	10.2%	10.3%	10.5%	11.0%	10.7%	10.2%
	Controls	3.4%	3.8%	4.0%	4.0%	4.1%	4.5%	4.2%	4.1%
<b>Type 2 Diabetes Mellitus</b>									
	Sample size of T2DM, n	346,486	390,055	400,625	400,804	410,234	406,655	397,693	373,858
DCI	T2DM	1.9	2.0	2.0	2.1	2.1	2.1	2.2	2.2
	Controls	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6
ADCSI	T2DM	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.5
	Controls	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6
<b>Comorbid Conditions of T2DM</b>									
Hypertension	T2DM	72.8%	74.8%	75.8%	76.7%	77.2%	80.3%	80.5%	80.9%
	Controls	37.1%	38.6%	39.2%	40.0%	40.9%	43.0%	43.5%	44.2%
Dyslipidemia	T2DM	69.4%	72.0%	73.4%	74.4%	74.9%	78.5%	78.6%	78.9%
	Controls	37.1%	38.7%	39.3%	40.4%	41.1%	43.4%	43.3%	43.7%
<b>Microvascular Complications of T2DM</b>									
Retinopathy	T2DM	13.6%	13.5%	13.1%	13.2%	12.8%	13.4%	13.3%	13.2%
	Controls	1.9%	2.0%	2.1%	2.3%	2.3%	2.6%	2.7%	2.8%
Nephropathy	T2DM	9.8%	10.9%	11.2%	11.8%	12.3%	13.4%	14.2%	15.0%
	Controls	2.4%	2.8%	3.0%	3.3%	3.6%	4.0%	4.3%	4.6%
Neuropathy	T2DM	16.3%	17.0%	17.2%	17.5%	17.8%	19.0%	19.9%	20.8%
	Controls	4.5%	4.8%	4.8%	5.0%	5.1%	5.5%	5.7%	5.9%
<b>Macrovascular Complications of T2DM</b>									
IHD	T2DM	21.2%	21.5%	21.2%	21.1%	21.0%	21.7%	21.7%	21.4%
	Controls	9.8%	10.1%	10.0%	10.0%	10.0%	10.6%	10.8%	10.7%
PVD	T2DM	9.6%	10.0%	10.0%	10.3%	10.4%	10.9%	10.9%	10.9%
	Controls	2.5%	2.7%	2.8%	2.8%	2.9%	3.0%	3.0%	3.1%
CVD	T2DM	8.7%	9.4%	9.5%	9.7%	9.9%	10.3%	10.4%	10.4%
	Controls	4.9%	5.2%	5.3%	5.5%	5.6%	6.0%	6.1%	6.1%

ADCSI: Adapted Diabetes Complications Severity Index; CVD: cerebrovascular disease; DCI: Deyo-Charlson Comorbidity Index; IHD: ischemic heart disease; PVD: peripheral vascular disease; T1DM: type 1 diabetes mellitus; T2DM: type 2 diabetes mellitus.

**Supplemental Table 2. Healthcare resource utilization and HEDIS metrics of T1DM and T2DM in the US, 2007 - 2014**

	Cohorts								
	2007	2008	2009	2010	2011	2012	2013	2014	
<b>Type 1 Diabetes Mellitus</b>									
Sample size of T1DM, n	23,073	24,683	26,228	26,164	25,876	24,986	23,881	21,176	
All-cause hospitalization	T1DM	23.7%	23.0%	22.6%	22.4%	21.7%	22.5%	21.7%	20.8%
	Controls	8.4%	8.0%	8.1%	7.9%	7.6%	8.0%	7.6%	7.4%
All-cause ER visit	T1DM	23.7%	23.2%	23.4%	23.4%	23.3%	24.3%	23.9%	24.4%
	Controls	12.1%	12.4%	12.5%	12.5%	12.1%	13.6%	12.7%	13.0%
T1DM-related hospitalization		22.0%	21.3%	21.1%	21.0%	20.7%	21.5%	20.7%	19.8%
T1DM-related ER visit		18.2%	17.6%	18.0%	18.4%	18.3%	19.1%	19.2%	20.0%
HEDIS metrics									
≥1 HbA1c test		72.4%	73.6%	75.8%	76.9%	77.2%	79.5%	80.8%	79.7%
≥1 eye exam		44.3%	44.4%	44.1%	43.9%	46.4%	46.2%	46.8%	46.5%
≥1 LDL test		59.7%	60.4%	62.0%	63.1%	62.7%	65.0%	65.9%	64.4%
≥1 nephropathy test		41.9%	44.0%	46.1%	46.5%	47.2%	46.6%	48.2%	48.4%
<b>Type 2 Diabetes Mellitus</b>									
Sample size of T2DM, n	346,486	390,055	400,625	400,804	410,234	406,655	397,693	373,858	
All-cause hospitalization	T2DM	17.0%	17.0%	16.5%	16.2%	15.9%	16.1%	15.9%	15.8%
	Controls	9.5%	9.6%	9.4%	9.2%	9.1%	9.3%	9.2%	9.1%
All-cause ER visit	T2DM	17.7%	17.6%	17.9%	18.0%	18.5%	19.4%	19.5%	20.1%
	Controls	11.9%	12.0%	12.0%	12.2%	12.5%	13.3%	13.2%	13.8%
T2DM-related hospitalization		13.9%	13.8%	13.5%	13.2%	13.2%	13.3%	13.2%	13.1%
T2DM-related ER visit		10.4%	10.3%	10.7%	11.0%	11.5%	12.0%	12.2%	12.9%

HEDIS metrics									
≥1 HbA1c test	67.5%	67.1%	68.8%	70.0%	70.1%	72.5%	73.2%	71.3%	
≥1 eye exam	36.0%	36.7%	36.9%	36.7%	37.9%	38.0%	38.5%	38.0%	
≥1 LDL test	63.6%	63.2%	64.6%	65.0%	64.9%	66.9%	67.4%	64.6%	
≥1 nephropathy test	30.5%	31.9%	34.0%	34.4%	35.3%	35.6%	36.6%	36.3%	

ER: emergency room; HbA1c: hemoglobin A1c; HEDIS: Healthcare Effectiveness Data and Information Set; LDL: low-density lipoprotein; T1DM: type 1 diabetes mellitus; T2DM: type 2 diabetes mellitus.

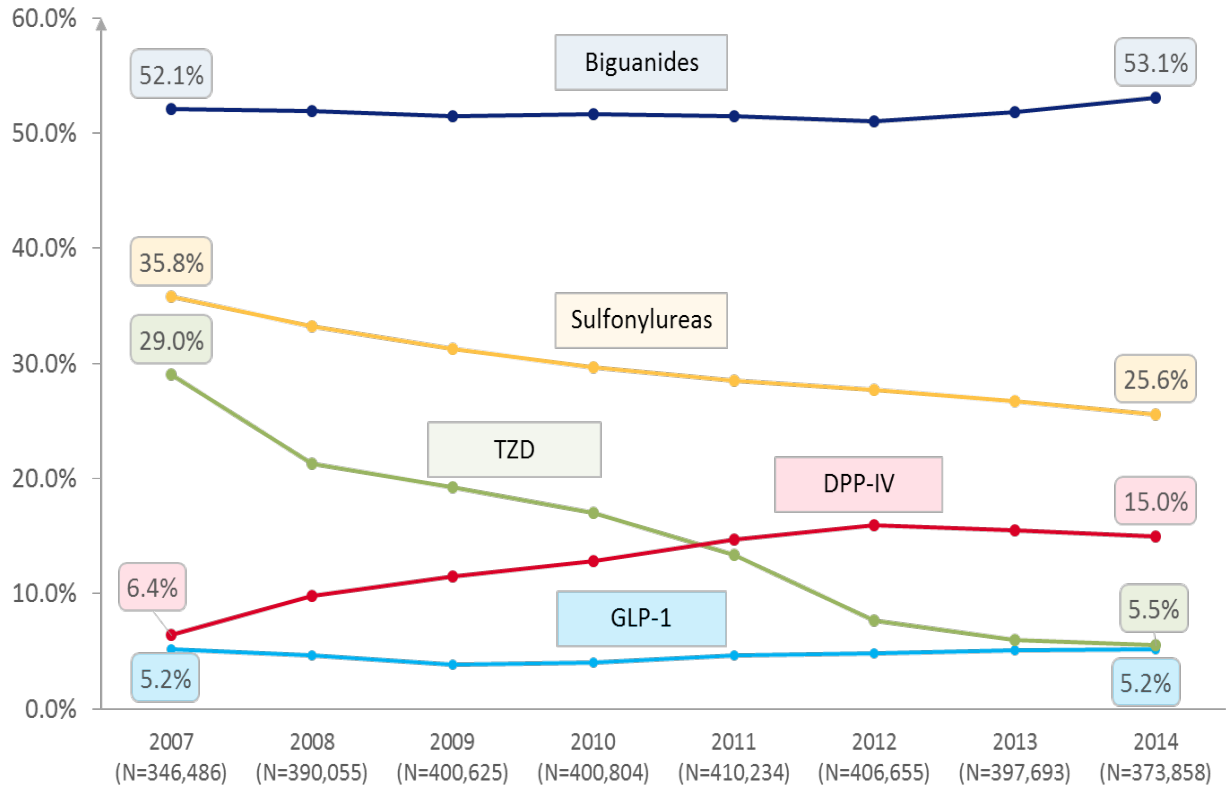
**Supplemental Table 3. Mean healthcare costs due to T1DM and T2DM estimated by 2 different cost estimation methods in the US, 2007 - 2014**

		Adjusted Annual Cost Estimates							
		2007	2008	2009	2010	2011	2012	2013	2014
<b>Type 1 Diabetes Mellitus</b>									
Sample size of T1DM, n		23,073	24,683	26,228	26,164	25,876	24,986	23,881	21,176
Method 1	<b>Total all-cause healthcare costs</b>	<b>\$23,261</b>	<b>\$22,756</b>	<b>\$24,437</b>	<b>\$24,345</b>	<b>\$25,251</b>	<b>\$24,347</b>	<b>\$25,736</b>	<b>\$25,855</b>
	T1DM cohort								
	Hospitalizations	\$5,427	\$5,677	\$6,486	\$6,248	\$5,686	\$5,452	\$5,396	\$4,767
	Emergency room visits	\$581	\$575	\$585	\$591	\$663	\$616	\$683	\$682
	Outpatient encounters	\$11,005	\$10,263	\$10,680	\$10,677	\$11,826	\$11,158	\$12,170	\$11,946
	Skilled nursing facility	\$222	\$308	\$328	\$356	\$274	\$359	\$307	\$290
	Pharmacy prescriptions	\$6,026	\$5,932	\$6,358	\$6,473	\$6,802	\$6,762	\$7,180	\$8,169
	<b>Total all-cause healthcare costs</b>	<b>\$6,596</b>	<b>\$8,610</b>	<b>\$8,730</b>	<b>\$8,575</b>	<b>\$9,925</b>	<b>\$8,936</b>	<b>\$9,070</b>	<b>\$8,389</b>
	Non-DM Control								
	Hospitalizations	\$1,096	\$1,642	\$1,478	\$1,544	\$1,840	\$1,781	\$1,582	\$1,453
	Emergency room visits	\$215	\$265	\$250	\$282	\$352	\$348	\$388	\$381
	Outpatient encounters	\$3,597	\$4,480	\$4,821	\$4,607	\$5,436	\$4,892	\$4,945	\$4,826
	Skilled nursing facility	\$31	\$128	\$122	\$113	\$102	\$210	\$61	\$71
	Pharmacy prescriptions	\$1,658	\$2,096	\$2,059	\$2,030	\$2,196	\$1,704	\$2,095	\$1,657
	<b>Total all-cause healthcare costs</b>	<b>\$16,665</b>	<b>\$14,146</b>	<b>\$15,707</b>	<b>\$15,770</b>	<b>\$15,325</b>	<b>\$15,412</b>	<b>\$16,666</b>	<b>\$17,466</b>
Difference									
Hospitalizations	\$4,332	\$4,036	\$5,008	\$4,705	\$3,847	\$3,670	\$3,814	\$3,314	
Emergency room visits	\$366	\$311	\$335	\$309	\$311	\$269	\$295	\$301	
Outpatient encounters	\$7,408	\$5,783	\$5,859	\$6,070	\$6,390	\$6,265	\$7,225	\$7,120	
Skilled nursing facility	\$192	\$180	\$206	\$243	\$172	\$149	\$246	\$219	
Pharmacy prescriptions	\$4,368	\$3,836	\$4,299	\$4,443	\$4,605	\$5,059	\$5,085	\$6,512	
Method 2	<b>Total direct T1DM attributable costs</b>	<b>\$6,115</b>	<b>\$6,087</b>	<b>\$6,756</b>	<b>\$7,027</b>	<b>\$7,732</b>	<b>\$7,837</b>	<b>\$8,215</b>	<b>\$9,331</b>
	Hospitalizations	\$188	\$177	\$191	\$208	\$194	\$207	\$198	\$180
	Emergency room visits	\$373	\$386	\$394	\$406	\$448	\$416	\$474	\$498
	Outpatient encounters	\$3,493	\$3,324	\$3,657	\$3,735	\$4,227	\$4,073	\$3,985	\$4,342
	Skilled nursing facility	\$127	\$164	\$198	\$211	\$148	\$225	\$153	\$167
	Pharmacy prescriptions	\$1,934	\$2,037	\$2,315	\$2,467	\$2,715	\$2,916	\$3,407	\$4,144
<b>Type 2 Diabetes Mellitus</b>									
Sample size of T2DM, n		346,486	390,055	400,625	400,804	410,234	406,655	397,693	373,858

Method 1	T2DM Cohort	<b>Total all-cause healthcare costs</b>	<b>\$14,514</b>	<b>\$14,184</b>	<b>\$15,145</b>	<b>\$15,439</b>	<b>\$15,616</b>	<b>\$14,584</b>	<b>\$15,454</b>	<b>\$15,716</b>
		Hospitalizations	\$3,205	\$3,132	\$3,456	\$3,364	\$3,128	\$3,014	\$3,153	\$2,967
		Emergency room visits	\$355	\$361	\$385	\$396	\$448	\$438	\$466	\$477
		Outpatient encounters	\$6,661	\$6,563	\$6,914	\$7,115	\$7,376	\$6,949	\$7,379	\$7,407
		Skilled nursing facility	\$118	\$168	\$196	\$194	\$197	\$201	\$218	\$210
	Pharmacy prescriptions	\$4,176	\$3,960	\$4,193	\$4,370	\$4,467	\$3,982	\$4,238	\$4,654	
	Non-DM Control	<b>Total all-cause healthcare costs</b>	<b>\$7,833</b>	<b>\$8,296</b>	<b>\$8,912</b>	<b>\$8,963</b>	<b>\$8,915</b>	<b>\$8,343</b>	<b>\$8,702</b>	<b>\$8,594</b>
		Hospitalizations	\$1,358	\$1,393	\$1,695	\$1,644	\$1,441	\$1,440	\$1,564	\$1,437
		Emergency room visits	\$217	\$244	\$251	\$266	\$289	\$287	\$308	\$333
		Outpatient encounters	\$4,201	\$4,497	\$4,752	\$4,873	\$5,002	\$4,706	\$4,916	\$4,835
Skilled nursing facility		\$49	\$103	\$118	\$124	\$110	\$124	\$118	\$125	
Pharmacy prescriptions	\$2,007	\$2,059	\$2,096	\$2,056	\$2,072	\$1,787	\$1,795	\$1,865		
Difference	<b>Total all-cause healthcare costs</b>	<b>\$6,681</b>	<b>\$5,888</b>	<b>\$6,233</b>	<b>\$6,475</b>	<b>\$6,702</b>	<b>\$6,241</b>	<b>\$6,752</b>	<b>\$7,122</b>	
	Hospitalizations	\$1,846	\$1,739	\$1,762	\$1,719	\$1,687	\$1,574	\$1,589	\$1,531	
	Emergency room visits	\$138	\$117	\$134	\$130	\$158	\$150	\$158	\$144	
	Outpatient encounters	\$2,460	\$2,066	\$2,162	\$2,242	\$2,375	\$2,243	\$2,463	\$2,572	
	Skilled nursing facility	\$69	\$65	\$79	\$70	\$87	\$77	\$100	\$85	
Pharmacy prescriptions	\$2,168	\$1,901	\$2,097	\$2,314	\$2,395	\$2,196	\$2,443	\$2,790		
Method 2	<b>Total direct T2DM attributable costs</b>	<b>\$2,955</b>	<b>\$3,112</b>	<b>\$3,485</b>	<b>\$3,688</b>	<b>\$4,082</b>	<b>\$3,962</b>	<b>\$4,334</b>	<b>\$4,663</b>	
	Hospitalizations	\$102	\$105	\$113	\$120	\$118	\$120	\$123	\$127	
	Emergency room visits	\$181	\$201	\$219	\$231	\$275	\$267	\$287	\$307	
	Outpatient encounters	\$1,570	\$1,622	\$1,816	\$1,893	\$2,137	\$2,093	\$2,270	\$2,271	
	Skilled nursing facility	\$55	\$92	\$105	\$102	\$104	\$110	\$112	\$108	
Pharmacy prescriptions	\$1,046	\$1,092	\$1,232	\$1,342	\$1,448	\$1,371	\$1,541	\$1,850		

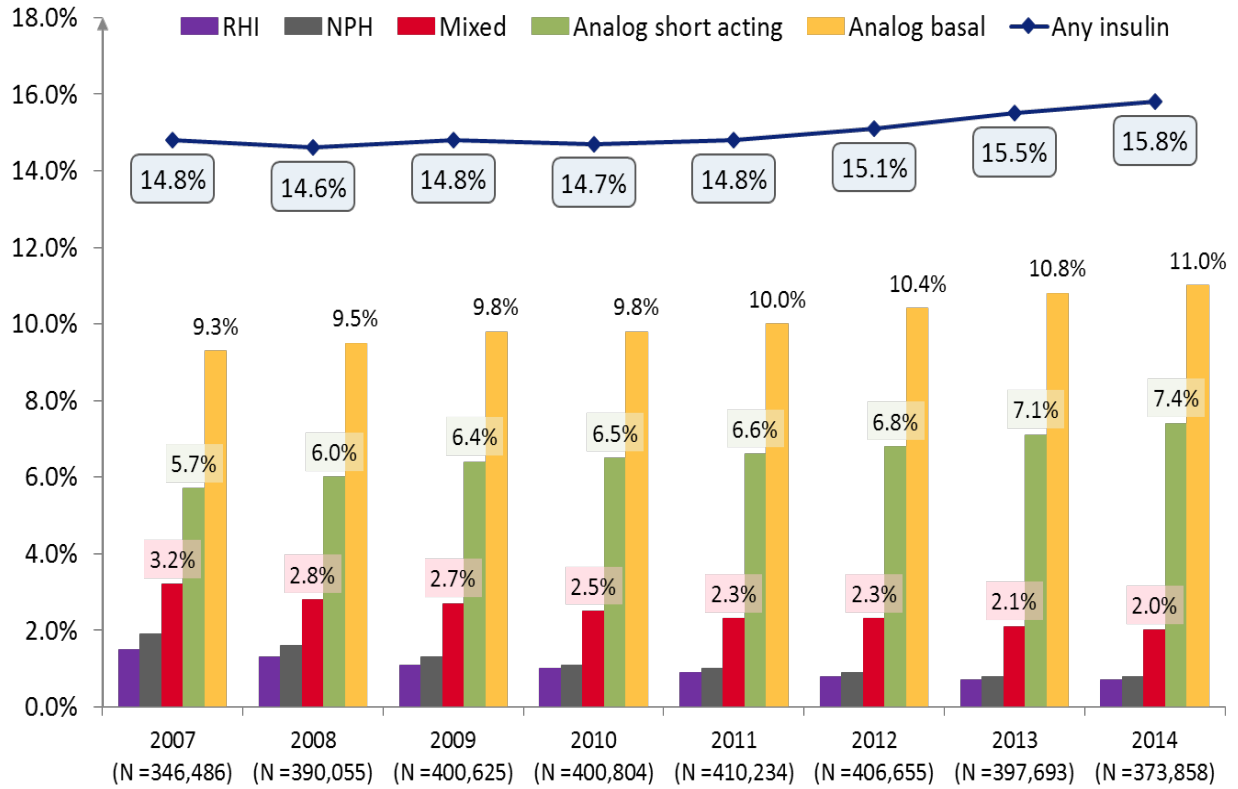
T1DM: type 1 diabetes mellitus; T2DM: type 2 diabetes mellitus

**Supplemental Figure 1. Use of non-insulin antidiabetic medications among T2DM in the US, 2007-2014**



DPP-IV: Dipeptidyl peptidase inhibitors; GLP-1: Glucagon-like peptide-1 Receptor Agonists; TZD: Thiazolidinediones; T2DM: type 2 diabetes mellitus.

**Supplemental Figure 2. Use of insulin among T2DM in the US, 2007-2014**



RHI: Regular Human Insulin; NPH: Neutral Protamine Hagedorn; T2DM: type 2 diabetes mellitus.