

Online Appendix

Table 1. Procedure and Diagnosis Codes Used to Identify Umbilical Hernia Repairs

PROCEDURE CODES	
CPT	
49580	Repair umbilical hernia, < 5 years, reducible
49585	Repair umbilical hernia, >5 years, reducible
49652	Laparoscopy, surgical, repair, ventral, umbilical, spigelian, or epigastric hernia, reducible
49659	Unlisted laparoscopy procedure, hernioplasty, herniorrhaphy, herniotomy
ICD-9-CM	
53.4	Repair of umbilical hernia
53.41	Other and open repair of umbilical hernia with graft or prosthesis
53.42	Laparoscopic repair of umbilical hernia with graft or prosthesis
53.43	Other laparoscopic umbilical herniorrhaphy
53.49	Other open umbilical herniorrhaphy
ICD-10-PCS	
0WQF0ZZ	Repair abdominal wall, open approach
0WQF3ZZ	Repair abdominal wall, percutaneous approach
0WQF4ZZ	Repair abdominal wall, percutaneous endoscopic approach
DIAGNOSIS CODES	
ICD-9-CM	
553.1	Umbilical hernia without mention of obstruction or gangrene
ICD-10-CM	
K42.9	Umbilical hernia without obstruction or gangrene

Patients had to have both a procedure code and a diagnosis code

Table 2. Metropolitan Statistical Areas (MSAs) included in the study

Albany-Schenectady-Troy, NY	Milwaukee-Waukesha-West Allis, WI
Albuquerque, NM	Minneapolis-St. Paul-Bloomington, MN-WI
Ann Arbor, MI	Monroe, MI
Atlanta-Sandy Springs-Roswell, GA	Myrtle Beach-Conway-North Myrtle Beach, SC-NC
Augusta-Richmond County, GA-SC	Nashville-Davidson--Murfreesboro--Franklin, TN
Austin-Round Rock, TX	Nassau County-Suffolk County, NY
Baltimore-Columbia-Towson, MD	Newark, NJ-PA
Baton Rouge, LA	New Haven-Milford, CT
Beaumont-Port Arthur, TX	New Orleans-Metairie, LA
Boise City, ID	North Port-Sarasota-Bradenton, FL
Bridgeport-Stamford-Norwalk, CT	Oakland-Hayward-Berkeley, CA
Cambridge-Newton-Framingham, MA	Ogden-Clearfield, UT
Charleston-North Charleston, SC	Oklahoma City, OK
Charlotte-Concord-Gastonia, NC-SC	Omaha-Council Bluffs, NE-IA
Chattanooga, TN-GA	Orlando-Kissimmee-Sanford, FL
Chicago-Naperville-Arlington Heights, IL	Oxnard-Thousand Oaks-Ventura, CA
Cincinnati, OH-KY-IN	Palm Bay-Melbourne-Titusville, FL
Cleveland-Elyria, OH	Pensacola-Ferry Pass-Brent, FL
Columbia, SC	Phoenix-Mesa-Scottsdale, AZ
Corpus Christi, TX	Portland-South Portland, ME
Dallas-Plano-Irving, TX	Port St. Lucie, FL
Dayton, OH	Providence-Warwick, RI-MA
Des Moines-West Des Moines, IA	Provo-Orem, UT
Detroit-Dearborn-Livonia, MI	Raleigh, NC
Durham-Chapel Hill, NC	Richmond, VA
El Paso, TX	Riverside-San Bernardino-Ontario, CA
Evansville, IN-KY	Roanoke, VA
Flint, MI	Rochester, NY
Fort Wayne, IN	Rockford, IL
Fort Worth-Arlington, TX	Rockingham County-Strafford County, NH
Fresno, CA	Sacramento--Roseville--Arden-Arcade, CA
Grand Rapids-Wyoming, MI	St. Louis, MO-IL
Greensboro-High Point, NC	Salt Lake City, UT
Greenville-Anderson-Mauldin, SC	San Antonio-New Braunfels, TX
Hartford-West Hartford-East Hartford, CT	San Diego-Carlsbad, CA
Houston-The Woodlands-Sugar Land, TX	San Francisco-Redwood City-South San Francisco, CA
Indianapolis-Carmel-Anderson, IN	San Jose-Sunnyvale-Santa Clara, CA
Kansas City, MO-KS	Savannah, GA
Knoxville, TN	Seattle-Bellevue-Everett, WA
Lafayette, LA	Stockton-Lodi, CA
Lake County-Kenosha County, IL-WI	Tacoma-Lakewood, WA
Lakeland-Winter Haven, FL	Tampa-St. Petersburg-Clearwater, FL
Lansing-East Lansing, MI	Toledo, OH
Lexington-Fayette, KY	Trenton, NJ
Lincoln, NE	Tucson, AZ
Little Rock-North Little Rock-Conway, AR	Washington-Arlington-Alexandria, DC-VA-MD-WV
Los Angeles-Long Beach-Glendale, CA	Wilmington, DE-MD-NJ
Louisville/Jefferson County, KY-IN	Wilmington, NC
McAllen-Edinburg-Mission, TX	Winston-Salem, NC
Memphis, TN-MS-AR	Worcester, MA-CT

Table 3. Results of instrumental variable analyses to estimate the association of CDHPs or HDHPs with the probability of umbilical hernia repair being performed before age 4 years or after age 5 years

Outcome	CDHPs vs. all other types of health plans besides HDHPs		HDHPs vs. all other types of health plans besides HDHPs	
	Risk difference (95% CI)	P	Risk difference (95% CI)	P
Surgery before age 4 years	0.051 (-0.257-0.358)	0.75	0.049 (-0.249-0.347)	0.75
Surgery after age 5 years	0.029 (-0.318-0.376)	0.87	0.028 (-0.309-0.364)	0.87

Results are from two-stage least squares regression models with heteroscedasticity-robust standard errors and that included MSA, year, child sex, the presence of any chronic condition, whether a concurrent surgical procedure was performed, and the MSA/year-level median household income in households with children and MSA/year-level percentage of children of non-Hispanic White race/ethnicity. MSA=metropolitan statistical area, CDHP=consumer-directed health plan HDHP=high deductible health plan

Table 4. Results of instrumental variable analyses to estimate the association of HDHPs with the probability of umbilical hernia repair being performed before age 4 years or after age 5 years: excluding children with concurrent surgical procedures

	Risk difference (95% CI)	P
Surgery before age 4 years	-0.014 (-0.184-0.155)	0.87
Surgery after age 5 years	0.028 (-0.169-0.225)	0.78

Results are from two-stage least squares regression models with heteroscedasticity-robust standard errors and that included MSA, year, child sex, the presence of any chronic condition, and the MSA/year-level median household income in households with children and MSA/year-level percentage of children of non-Hispanic White race/ethnicity.

MSA=metropolitan statistical area, HDHP=high deductible health plan

Figure 1. Month of umbilical hernia repair by high deductible health plan status in children under 4 years of age.

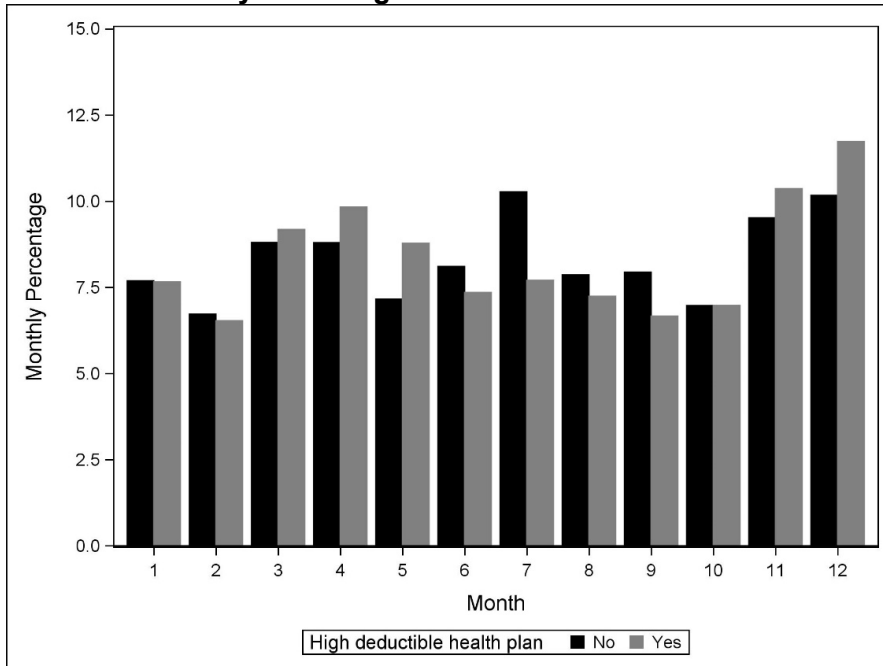


Figure 2. Month of umbilical hernia repair by high deductible health plan status in children older than 5 years of age.

