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****************************************************************************************;
*   Program:            combined_comorbidity_score_code.sas                              ;
*                                                                                       ;
*   Purpose:            To compute combined comorbidity scores based on ICD-9 codes      ;
*                                                                                       ;
*       Description:    This code takes in a list of ICD-9 codes for                     ;
*                                                                                       ;
*   Citation:           Gagne JJ, Glynn RJ, Avorn J, Levin R, Schneeweiss S. A combined   ;
*                       comorbidity score predicted mortality in elderly patients better  ;
*                       than existing scores. Journal of Clinical Epidemiology 2011 Jan   ;
*                       3 [Epub ahead of print]                                           ;
*                                                                                       ;
*       Definitions:    datain = input datset                                            ;
*                                                                                       ;
*                       ICD9variable = ICD-9 codes                                       ;
*                                                                                       ;
*       Comments:               After merging the final data file (combinedcomorbidityscore) with       ;
*                               the analytic data file, patients with missing combined comorbidity      ;
*                               score values (i.e. combinedscore = .) should be set to 0 as these       ;
*                               patients did not have any of the component conditions.                  ;
*                                                                                       ;
****************************************************************************************;


data conditions;
    set datain(rename=(ICD9variable = ICD));

        length disease $25;
        disease = 'nopoints';

        if substr(ICD,1,3) = '196' or substr(ICD,1,3) = '197' or
        substr(ICD,1,3) = '198' or substr(ICD,1,3) = '199'
                                                    then disease = 'metastatic_romano';

        if ICD = '40201' or ICD = '40211' or ICD = '40291' or
        substr(ICD,1,4) = '4293' or substr(ICD,1,3) = '425' or
        substr(ICD,1,3) = '428'         then disease = 'chf_romano';

        if substr(ICD,1,4) = '3310' or substr(ICD,1,4) = '3311' or
        substr(ICD,1,4) = '3312' or     substr(ICD,1,3) = '290'
                                                    then disease = 'dementia_romano';

        if ICD = '40311' or ICD = '40391' or ICD = '40412' or
        ICD = '40492' or substr(ICD,1,3) = '585' or
        substr(ICD,1,3) = '586' or substr(ICD,1,4) = 'V420' or
        substr(ICD,1,4) = 'V451' or substr(ICD,1,4) = 'V560' or
        substr(ICD,1,4) = 'V568'        then disease = 'renal_elixhauser';

        if '260' <= substr(ICD,1,3) <= '263'
                                                    then disease = 'wtloss_elixhauser';

        if substr(ICD,1,3) = '342' or substr(ICD,1,3) = '344'
                                                    then disease = 'hemiplegia_romano';

        if substr(ICD,1,4) = '2911' or substr(ICD,1,4) = '2912' or
        substr(ICD,1,4) = '2915' or substr(ICD,1,4) = '2918' or
        substr(ICD,1,4) = '2919'                            or
        '30390' <= ICD <= '30393'       or
        '30500' <= ICD <= '30503'       or substr(ICD,1,4) = 'V113'
                                                    then disease = 'alcohol_elixhauser';

        if '140' <= substr(ICD,1,3) <= '171'    or
        '174' <= substr(ICD,1,3) <= '195'               or
        substr(ICD,1,4) = '2730'                        or
        substr(ICD,1,4) = '2733'                        or
        substr(ICD,1,5) = 'V1046'                       or
        '200' <= substr(ICD,1,3) <= '208'
                                                    then disease = 'tumor_romano';

        if ICD = '42610' or ICD = '42611' or ICD = '42613' or
        '4262' <= substr(ICD,1,4) <= '4264' or
        '42650' <= ICD <= '42653'                       or
        '4266' <= substr(ICD,1,4) <= '4268'     or
        substr(ICD,1,4) = '4270' or substr(ICD,1,4) = '4272' or
        ICD = '42731' or ICD = '42760' or substr(ICD,1,4) = '4279' or
        substr(ICD,1,4) = '7850' or substr(ICD,1,4) = 'V450' or
        substr(ICD,1,4) = 'V533'
                                                    then disease = 'arrhythmia_elixhauser';

        if substr(ICD,1,4) = '4150' or substr(ICD,1,4) = '4168' or
        substr(ICD,1,4) = '4169' or substr(ICD,1,3) = '491'  or
        substr(ICD,1,3) = '492'  or substr(ICD,1,3) = '493'  or
        substr(ICD,1,3) = '494'  or substr(ICD,1,3) = '496'
                                                    then disease = 'pulmonarydz_romano';

        if '2860' <= substr(ICD,1,4) <= '2869'  or
        substr(ICD,1,4) = '2871'                        or
        '2873' <= substr(ICD,1,4) <= '2875'
                                                    then disease = 'coagulopathy_elixhauser';

        if '25040' <= ICD <= '25073'                    or
        '25090' <= ICD <= '25093'       then disease = 'compdiabetes_elixhauser';

        if '2801' <= substr(ICD,1,4) <= '2819'  or
        substr(ICD,1,4) = '2859'        then disease = 'anemia_elixhauser';
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        if '2760' <= substr(ICD,1,4) <= '2769'
                                              then disease = 'electrolytes_elixhauser';

        if ICD = '07032' or ICD = '07033' or ICD = '07054' or
        substr(ICD,1,4) = '4560' or substr(ICD,1,4) = '4561' or
        ICD = '45620' or ICD = '45621' or
        substr(ICD,1,4) = '5710' or substr(ICD,1,4) = '5712' or
        substr(ICD,1,4) = '5713' or
        '57140' <= ICD <= '57149' or substr(ICD,1,4) = '5715' or
        substr(ICD,1,4) = '5716' or substr(ICD,1,4) = '5718' or
        substr(ICD,1,4) = '5719' or substr(ICD,1,4) = '5723' or
        substr(ICD,1,4) = '5728' or substr(ICD,1,4) = 'V427'
                                              then disease = 'liver_elixhauser';

        if '4400' <= substr(ICD,1,4) <= '4409' or
        substr(ICD,1,4) = '4412' or     substr(ICD,1,4) = '4414' or
        substr(ICD,1,4) = '4417' or substr(ICD,1,4) = '4419' or
        '4431' <= substr(ICD,1,4) <= '4439' or
        substr(ICD,1,4) = '4471' or substr(ICD,1,4) = '5571' or
        substr(ICD,1,4) = '5579' or substr(ICD,1,4) = 'V434'
                                              then disease = 'pvd_elixhauser';

        if '29500' <= ICD <= '29899' or
        ICD = '29910' or ICD = '29911'
                                              then disease = 'psychosis_elixhauser';

        if substr(ICD,1,3) = '416' or substr(ICD,1,4) = '4179'
                                              then disease = 'pulmcirc_elixhauser';

        if substr(ICD,1,3) = '042' or substr(ICD,1,3) = '043' or
        substr(ICD,1,3) = '044'          then disease = 'hivaids_romano';

        if substr(ICD,1,4) = '4011' or substr(ICD,1,4) = '4019' or
        ICD = '40210' or ICD = '40290' or ICD = '40410' or ICD = '40490' or
        ICD = '40511' or ICD = '40519' or ICD = '40591' or ICD = '40599'
                                              then disease = 'hypertension_elixhauser';

        if disease ^= 'nopoints';
run;

proc sort nodupkey data = conditions;
    by uniqueidentifier disease;
run;

*Applying the weights;
data conditionweights;
        set conditions;

        weight = 0;

        if disease = 'metastatic_romano'          then weight = 5;
        if disease = 'chf_romano'                        then weight = 2;
        if disease = 'dementia_romano'            then weight = 2;
        if disease = 'renal_elixhauser'           then weight = 2;
        if disease = 'wtloss_elixhauser'          then weight = 2;
        if disease = 'hemiplegia_romano'          then weight = 1;
        if disease = 'alcohol_elixhauser'         then weight = 1;
        if disease = 'tumor_romano'                      then weight = 1;
        if disease = 'arrhythmia_elixhauser'    then weight = 1;
        if disease = 'pulmonarydz_romano'         then weight = 1;
        if disease = 'coagulopathy_elixhauser'  then weight = 1;
        if disease = 'compdiabetes_elixhauser'  then weight = 1;
        if disease = 'anemia_elixhauser'            then weight = 1;
        if disease = 'electrolytes_elixhauser'  then weight = 1;
        if disease = 'liver_elixhauser'             then weight = 1;
        if disease = 'pvd_elixhauser'               then weight = 1;
        if disease = 'psychosis_elixhauser'         then weight = 1;
        if disease = 'pulmcirc_elixhauser'          then weight = 1;
        if disease = 'hivaids_romano'                 then weight = -1;
        if disease = 'hypertension_elixhauser'  then weight = -1;

        keep uniqueidentifier disease weight;
run;

*Summing the weights;
data combinedcomorbidityscore;
        set conditionweights(keep = uniqueidentifier weight);

        by uniqueidentifier;
                if first.uniqueidentifier then combinedscore = 0;
                        combinedscore + weight;
                if last.uniqueidentifier then output;

keep uniqueidentifier combinedscore;
run;

*Note: patients not included in the final data set (combinedcomorbidityscore) did not
have any of the component conditions. Therefore, be sure to set their combined comorbidity
score values to zero;
```